

PROJECT MANUAL

for



VA SAN DIEGO HEALTHCARE SYSTEM RENOVATE DENTAL TO AMBULATORY CARE (PHASE 3)

DEPARTMENT OF VETERANS AFFAIRS
3350 La Jolla Village Drive
San Diego, CA 92161

VA PROJECT NO. 664-12-118
GKKWORKS PROJECT NO. 40086

Prepared By

gkkworks

1775 Hancock Street, Suite 150
San Diego, CA 92110
TEL: 619.389.0215
FAX: 949.814.1249

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**DEPARTMENT OF VETERANS AFFAIRS
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SECTION 01 00 00**GENERAL REQUIREMENTS****1.1 GENERAL INTENTION**

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for RENOVATE AMBULATORY CARE DESIGN BID DOCS(PHASE 3), as required by drawings and specifications.
- B. Visits to the site by Bidders may be made only by appointment with the Medical Center Engineering Officer.
- C. Offices of GKKWorks Architects, 1775 Hancock Street, Suite 150, San Diego, CA 92110 as Architect-Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.
- 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. Two forms of government issued ID's are required. One of which shall be a Photo ID.
- E. Prior to commencing work, general contractor shall provide proof that a OSHA certified "competent person" (CP) (29 CFR 1926.20(b)(2) will maintain a presence at the work site whenever the general or subcontractors are present. (30-hour OSHA certified Construction Safety course)
- F. Training:

1. All employees of general contractor or subcontractors shall have the 10-hour OSHA certified Construction Safety course and or other relevant competency training, as determined by VA CP with input from the ICRA team.
2. Submit training records of all such employees for approval before the start of work.

1.2 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, 1 set of specifications and drawings plus a CD-ROM will be furnished.
- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense, from the CD-ROM.

1.3 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 sub-contractors working on the project and their employees also comply with these regulations.
- B. Security Procedures:
 1. General Contractor's employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.

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

F. Motor Vehicle Restrictions

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

1.4 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):

E84-2008 Surface Burning Characteristics of Building Materials

2. National Fire Protection Association (NFPA):

10-2006 Standard for Portable Fire Extinguishers

30-2007 Flammable and Combustible Liquids Code

51B-2003 Standard for Fire Prevention During Welding, Cutting
and Other Hot Work

70-2007 National Electrical Code

241-2004 Standard for Safeguarding Construction, Alteration, and
Demolition Operations

3. Occupational Safety and Health Administration (OSHA):

29 CFR 1926 Safety and Health Regulations for Construction

- 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 Project Engineer and Facility Safety Officer for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES Prior to any worker for the contractor or subcontractors beginning work, they 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. Documentation shall be provided to the Resident Engineer that individuals have undergone contractor's safety briefing.

- C. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- E. Temporary Construction Partitions:
 - 1. Install and maintain temporary construction partitions to provide smoke-tight separations between construction areas and adjoining areas. Construct partitions of gypsum board on both sides of metal steel studs. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
 - 2. Install one-hour temporary construction partitions as shown on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.
 - 3. 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 Project Engineer and facility Safety Officer.

- H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Project Engineer and facility Safety Officer.
- I. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- J. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- K. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with Project Engineer and facility Safety Officer. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the Resident Engineer.
- L. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Project Engineer and facility Safety Officer.
- M. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Obtain permits from facility Safety Officer at least 24 hours in advance.
- O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Project Engineer.
- P. 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. Fines for violations of Fire Safety Requirements.
 - 1. 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.
 - 2. Disposed of waste and debris in accordance with NFPA 241. Remove from buildings daily.
 - 3. Tripping, setting off, of fire alarms and /or flow switches, without proper notification is a violation fineable at the minimum of \$2,500 per offense plus expenses.
 - 4. Smoke detectors that were bagged, covered, or any way rendered inoperable during work shift must be made operable at the end of said work shift. This offense is fineable at the minimum of \$2,500 per offense plus expenses.
 - 5. Any false alarms that causes a visit by the fire department is fineable at the minimum of \$2,500 per offense plus expenses.
 - 6. Hot Work: The following offenses are a violation fineable at a minimum of \$2,500 per offense plus expenses: a) Failure to obtain a hot work permit prior to work, b) Failure to maintain Fire Watch, as required during Hot Work, and c) Failure to remove smoke detector cover after said Hot Work is completed at the end of the work shift for the day, whichever is sooner.

7. Fines for Open Fire Doors: Fire doors at all times shall be kept closed, where required. These doors shall not be left open in any manner; they shall not be propped or tied open. Violations are fineable at no less than \$2,500 per violation plus expenses. These fines will be imposed due to contractor's fault, negligence or failure to comply with NFPA codes and VA Policies.

1.5 OPERATIONS AND STORAGE AREAS

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.
- B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.
- C. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

(FAR 52.236-10)

- D. Working space and space available for storing materials shall be as determined by the Resident Engineer.
- E. Workers are subject to rules of Medical Center applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by Resident Engineer where required by limited working space.
 - 1. Do not store materials and equipment in other than assigned areas.
 - 2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.
 - 3. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.
- G. The Building will be occupied during performance of work; but immediate areas of alterations will be vacated.
- H. When a area is turned over to Contractor, Contractor shall accept entire responsibility therefore.
 - 1. Contractor shall maintain in operating condition existing fire protection and alarm equipment.

- I. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by Resident Engineer.
 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 Project Engineer. 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.
 - a. Interruption of Utilities: A monetary fine, at a minimum of \$2,500 plus expenses, will be levied, if any utility service is interrupted in any area of the facility without proper notification and authorization, i.e., "Utility Shutdown Notice"
 2. Contractor shall submit a request to interrupt any such services to Resident Engineer, in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
 3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Medical Center. Interruption time approved by Medical Center may occur at other than Contractor's normal working hours at no cost to the government.

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 Resident Engineer.
 5. In case of a contract construction emergency, service will be interrupted on approval of Resident Engineer. Such approval will be confirmed in writing as soon as practical.
 6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.
- J. 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.
- K. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:
1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.
 2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the Resident Engineer.
- L. Coordinate the work for this contract with other construction operations as directed by Resident Engineer. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

1.6 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the Project Engineer of areas of the building in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both, to the Contracting Officer. 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 Resident Engineer.
- B. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and Resident Engineer together shall make a thorough re-survey of the areas of the building. 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.

C. 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.

1.7 INFECTION PREVENTION MEASURES

- A. Implement the requirements of VAMC's Infection Control Risk Assessment (ICRA) team. ICRA Group may monitor dust in the vicinity of the construction work and require the Contractor to take corrective action immediately if the safe levels are exceeded.
- B. Establish and maintain a dust control program as part of the contractor's infection preventive measures in accordance with the guidelines provided by ICRA Group. Prior to start of work, prepare a plan detailing project-specific dust protection measures, including periodic status reports, and submit to Project Engineer 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 Project Engineer 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 Resident Engineer. 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 Project Engineer. 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 one-hour 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 Resident Engineer and Medical Center.

- b. HEPA filtration is required where the exhaust dust may reenter the breathing zone. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. Install HEPA (High Efficiency Particulate Accumulator) filter vacuum system rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. Ensure continuous negative air pressures occurring within the work area. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Exhaust hoses shall be heavy duty, flexible steel reinforced and exhausted so that dust is not reintroduced to the medical center.
- c. Adhesive Walk-off/Carpet Walk-off Mats, minimum 600mm x 900mm (24" x 36"), shall be used at all interior transitions from the construction area to occupied medical center area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.
- d. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as they are created. Transport these outside the construction area in containers with tightly fitting lids.
- e. The contractor shall not haul debris through patient-care areas without prior approval of the Resident Engineer and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.

- f. Using a HEPA vacuum, clean inside the barrier and vacuum ceiling tile prior to replacement. Any ceiling access panels opened for investigation beyond sealed areas shall be sealed immediately when unattended.
- g. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.
- h. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.

E. Final Cleanup:

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

1.8 DISPOSAL AND RETENTION

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

1. Reserved items which are to remain property of the Government are identified by attached tags. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by Project Engineer.
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.

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

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

(FAR 52.236-9)

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

1.10 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the Resident Engineer. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the Resident Engineer before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2) of Section 00 72 00, GENERAL CONDITIONS.

1.11 AS-BUILT DRAWINGS

- A. The contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.

- B. All variations shall be shown in the same general detail as used in the contract drawings. To ensure compliance, as-built drawings shall be made available for the Resident Engineer's review, as often as requested.
- C. Contractor shall deliver two approved completed sets of as-built drawings to the Resident Engineer within 15 calendar days after each completed phase and after the acceptance of the project by the Resident Engineer.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.12 USE OF ROADWAYS

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

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

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

1.14 TEMPORARY USE OF EXISTING ELEVATORS

- A. Use of a designated existing elevator for handling building materials and Contractor's personnel will be permitted subject to following provisions:

1. Contractor makes all arrangements with the Project Engineer for use of elevators. The Project Engineer will ascertain that elevators are in proper condition. Contractor may use service elevator No. 1 in Building 500 for daily use.
2. Contractor covers and provides maximum protection of following elevator components:
 - a. Entrance jambs, heads soffits and threshold plates.
 - b. Entrance columns, canopy, return panels and inside surfaces of car enclosure walls.
 - c. Finish flooring.
3. Government will accept hoisting ropes of elevator and rope of each speed governor if they are worn under normal operation. However, if these ropes are damaged by action of foreign matter such as sand, lime, grit, stones, etc., during temporary use, they shall be removed and replaced by new hoisting ropes.
4. If brake lining of elevators are excessively worn or damaged during temporary use, they shall be removed and replaced by new brake lining.

5. All parts of main controller, starter, relay panel, selector, etc., worn or damaged during temporary use shall be removed and replaced with new parts, if recommended by elevator inspector after elevator is released by Contractor.
6. Place elevator in condition equal, less normal wear, to that existing at time it was placed in service of Contractor as approved by Contracting Officer.

1.15 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.

1.16 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 Contractor shall carefully conserve any utilities furnished without charge.

1.17 NEW TELEPHONE EQUIPMENT

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

1.18 TESTS

- A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.

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

1.19 INSTRUCTIONS

- A. Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals (four copies each) for each separate piece of equipment shall be delivered to the Resident Engineer coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment,

component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

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

1.20 GOVERNMENT-FURNISHED PROPERTY

- A. The Government shall deliver to the Contractor, the Government-furnished property shown on the drawings.
- B. Equipment furnished by Government to be installed by Contractor will be furnished to Contractor at the Medical Center.
- C. Storage space for equipment will be provided by the Government and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the Medical Center.

- D. Notify Contracting Officer in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.
1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
 2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.
- E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, elbows, 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.

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SECTION 01 00 11

SPECIAL REQUIREMENTS

- 1.1 PARKING REGULATIONS - Contractor/Vendor parking shall be kept to a minimum and carpooling of workers must be encouraged. Limited contractor parking is available on a first come first serve basis in designated areas on the north service road behind the medical center. Parking permits must be issued by the VA and displayed on the vehicle dashboard before using this area. Limited contractor parking is made available at Building 2, Power Plant, for authorized work in Building 2 only. All other contractor/vendor parking shall utilize the visitor Parking Lot #3 in front of the medical center. Unauthorized parking is subject to a Federal citation. Parking permits are issued in the Engineering Office, Room BB108.
- 1.2 IDENTIFICATION BADGES - All contractor/vendor personnel shall wear some type of identification. Uniforms or clothing identifying the company name or contractor provided identification badges are considered acceptable. Individuals not having their own acceptable identification shall wear a visitor identification badge provided by the VA. These badges are to be signed for each day at the Police Office at the main entrance to the medical center and turned in each day upon leaving. Individuals with long term work can make special arrangements to have the badges assigned for longer time periods.
- 1.3 SMOKING POLICY - Smoking is permitted only in designated areas. No smoking is allowed within the building. The main designated smoking area is outside of Building #1 on the second floor northwest exterior patio deck. Smoking is not allowed on the grounds, in parking lots, or in other buildings.
- 1.4 DRESS CODE - Shoes and shirts must be worn at all times. Contractors are expected to dress appropriately as this is a public health care facility.
- 1.5 LANGUAGE - Contractors are expected to use appropriate language as this is a public health care facility. Obscene language is not permitted and all individuals are expected to be courteous. This requirement includes the interstitial as conversations can be heard by the public below these spaces.
- 1.6 NOISE AND DISRUPTION - Work is being conducted in an occupied health care facility with surgical and medial patients. The contractor is required to continuously consider the impact to the medical center in completing the required work. Any jackhammering, drilling, or operation causing excessive noise or vibration must be planned in advance with the assigned VA contact person. Consideration must be given to occupancies above, below, and adjacent to the contractor's work area. Also movement of equipment, supplies, and waste through occupied areas, corridors, and elevators must be planned and scheduled to minimize interruption to hospital operations.
- 1.7 WORKING OVER PATIENT AREAS - In general the lay in suspended acoustic ceiling is the only barrier between the interstitial space and the use area below. Any work involving the transport or installation of materials over patient areas requires a minimum of 24 hour notice so the space below can be vacated to minimize the risk of objects falling through the ceiling. This includes but is not limited to activities such as installing pipe, conduit, duct, reheat boxes, etc. (Work in fan rooms, on catwalks, and above solid ceilings is excluded from this requirement.)

- 1.8 ISSUANCE OF KEYS - Keys as deemed appropriate will be issued to the contractor for access to construction areas, interstitial, electrical panels, equipment rooms, and elevators. Keys will be issued by Engineering in room BB108.
- 1.9 CONTRACTOR STORAGE - Storage is not allowed on balconies, in corridors, or anywhere where it would block access to equipment or exits. If an area is turned over to a contractor for the duration of a project he may use that area for storage. Other designated storage areas may be assigned if available. Areas on the grounds will be made available where possible for contractor furnished storage containers or dumpsters. All debris, trash, and packaging materials shall be disposed of off station in a timely manner.
- 1.10 DESIGNATED POINT OF CONTACT - Contractor will be given the name of an individual that will be the designated point of contact for coordinating and overseeing the day to day operation of the contractors work performance. The contractor is responsible for checking in each day he on station with that individual so that the VA knows where the contractor is working and what work is being performed.
- 1.11 USE OF FACILITY EQUIPMENT - Contractors/vendors are to provide all tools, labor, equipment, and materials to accomplish their work unless otherwise specified or if specifically authorized by the VA under special circumstances. This includes use of ladders, dumpster, hand tools, drop lights, flatbed carts, dollies, etc.
- 1.12 RECEIPT OF CONTRACTOR MATERIAL - Contractor is allowed to have deliveries made directly to the VA as long as they coordinate the delivery and have a representative on site to receive, off load, and store the shipment. The VA warehouse will refuse receipt of any contractor delivery.
- 1.13 WELDING / CUTTING PERMITS - The contractor shall fill out a VA supplied permit form for any welding, soldering, brazing, and torch cutting and have it approved prior to accomplishing any hot work. Permits are good only for one day and contractor is responsible for adhering to specified requirements stated on the permit.
- 1.14 UTILITY SHUTDOWNS - Shutdown of any utility, alarm, communication, or fire protection system must be coordinated and scheduled in advance. Contractor shall follow OSHA lockout/tagout procedures while systems are shutdown. Contractor shall coordinate reactivation of all systems upon completion of work.
- 1.15 MEDICAL GASES - All brazing, testing, calibration, and work on medical gas systems must be accomplished by certified mechanics.
- 1.16 AFTER HOURS WORK AUTHORIZATIONS - All work accomplished between 4:30 PM and 7:00 AM on weekdays, work on weekends, and work on holidays must be scheduled in advance and a form filed. Forms are available in Room BB108, Engineering, and must include the date, time, area of work, and names of individuals involved. The contractor must check in with the Police at the main entrance prior to beginning after hours work.
- 1.17 SEISMIC BRACING - All installations in the medical center must have lateral bracing installed to meet or exceed the requirements listed in the current edition of the Uniform Building Code.
- 1.18 EMERGENCY PHONE NUMBERS - Contractors/vendors shall furnish the VA with after hours emergency phone numbers. These numbers will be used only in case of an emergency concerning the work being completed or space occupied by the contractor.

- 1.19 PCB BALLASTS/FLUORESCENT LAMPS - This facility originally was equipped with PCB containing ballasts in fluorescent light fixtures. Most of these ballasts have been removed. The contractor is responsible for checking any ballast prior to disposal. Any ballast not labeled "Non PCB" shall be turned over to the VA for disposal. Contractor is responsible for disposing of all fluorescent lamps in accordance with all local, state, and federal regulations.
- 1.20 MSDS - The contractor is responsible for having material data safety sheets available on site for all chemicals, solvents, cleaners, paints, adhesives, etc. used by the contractor and for following their precautions.
- 1.21 SAFETY EQUIPMENT - The contractor is responsible for wearing all safety equipment and taking all required precautions for fire and safety issues. This includes wearing goggles, face shields, safety shoes, and having fire extinguishers present. Contractor shall minimize the use of extension cords. All electrical cords shall be inspected and maintained to ensure integrity and proper grounding.
- 1.22 INTERSTITIAL WORK - Special care must be taken when working off of the catwalks in the interstitial so that data lines, pneumatic air lines, ducting, piping, and conduit is not damaged or stepped on. Should such damage occur contractor is to immediately notify VA Engineering. Any damage shall be repaired immediately at the contractor's expense. All contractor generated debris shall be cleaned up and removed from the interstitial. All asbestos waste bags shall be marked to show the contract number, the contractor's name, and the date the bag was started. All penetrations through walls and floor slabs shall be fully patched.
- 1.23 CELLULAR PHONES - Cellular phones are prohibited for use in designated areas inside the building.
- 1.24 WALK OFF MATS - The contractor is responsible to provide walk off mats at each entrance or exit from a construction site. Walk off mats shall be 4' X 6' rubber backed, Golden Star 511-3A, or equal. Contractor shall thoroughly clean mat weekly and vacuum intermittently to control construction dust and debris from being tracked through the facility.
- 1.25 INTERIM INSPECTIONS - The contractor shall request for interim formal inspections by the VA prior to closing up walls or installing ceilings.
- 1.26 CORRESPONDENCE - All correspondence shall be original or (legible xerox copies may be accepted on approval). Fax copies shall be accepted only on an interim basis.
- 1.27 LATEX POWDER FREE ENVIRONMENT - The VA Medical Center is a latex powder free facility. Contractors are not to use any powdered latex gloves or other items which contain latex powder as some individuals have allergic reactions from the airborne particles.
- 1.28 CONTRACTOR STORAGE/STAGING - Contractor shall stage supplies and storage within designated construction areas only. No storage is allowed in corridors or on balcony areas of the medical center.

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SECTION 01 32 16.15

PROJECT SCHEDULES

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.
- B. Critical Path Method (CPM) schedules shall be compatible with Microsoft Project Window's Version for projected design delivery denoting mile stone dates of meetings and delivery's and construction schedules relating directly to the CSI technical specifications of each project(s). These schedules will reflect the Gantt chart type appearance of each specification section. They will denote: Activity, Day Duration, Projected Start Date, Projected Finish Date, Month/Quarter Calendar. They shall define critical project activities(s) as deemed necessary by the A/E. the VA will provide the A.E with the start date. Media will be in the form of 8.5x11 color hardcopy with electronic file to be provided.

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 (COTR).
- 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 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 five different reports (inclusive of all pages) available within the user defined reports of the scheduling software approved by the Contracting Officer; 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 COTR shall identify the five 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 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 ten calendar days from receipt of reports. The Contractor shall reprocess the computer-produced reports and associated diskette(s), when requested by the Contracting Officer's representative, to correct errors which affect the payment and schedule for the project.

1.4 PAYMENT TO THE CONTRACTOR:

- A. Monthly, the contractor shall submit the AIA application and certificate for payment documents G702 & 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.

1.5 PAYMENT AND PROGRESS REPORTING

- A. Monthly schedule update meetings will be held on dates mutually agreed to by the COTR 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 COTR three work days 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 Contracting Officer's representative 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 resident engineer. 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 fourteen (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, RE office representatives, and all subcontractors needed, as determined by the SRE, 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.

1.6 RESPONSIBILITY FOR COMPLETION

- A. If it becomes apparent from the current revised monthly progress schedule that phasing or 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 COTR 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.

1.7 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 Contracting Officer for approval.
- C. Contracting Officer'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 Contracting Officer or the VA representative.

- 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.

1.8 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 COTR 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 work days) 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 Contracting Officer'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 Contracting Officer's decision.
- C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer 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 work days) 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 RFI's, 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

SAMPLES AND SHOP DRAWINGS

- 1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in Section, GENERAL CONDITIONS.
- 1-2. For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1-3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
 - A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
 - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
 - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1-4. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.
- 1-5. Submittals will be reviewed for compliance with contract requirements by Project Manager or A/E, and action thereon will be taken by Project Manager on behalf of the Contracting Officer.
- 1-6. Upon receipt of submittals, Project Manager or A/E will assign a sequential 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 therefore by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.
- 1-8. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and A/E. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and A/E

assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.

- 1-9. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
 - A. Submit samples required by Section 09 06 00, INTERIOR/EXTERIOR FINISHES, MATERIALS, AND FINISH SCHEDULE, in quadruplicate. 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 or FAX and shall contain the list of items, name of Medical Center, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
 1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.
 2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Medical Center, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
 3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.
 - C. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
 1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
 2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
 3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.

4. Contractor shall send a copy of transmittal letter to both Project Manager and to Contracting Officer simultaneously with submission of material to a commercial testing laboratory.
 5. Laboratory test reports shall be sent directly to Project Manager 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 Project Manager at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.
- F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.
1. For each drawing required, submit one legible photographic paper or vellum reproducible.
 2. Reproducible shall be full size.
 3. Each drawing shall have marked thereon, proper descriptive title, including Medical Center location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
 4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
 5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
 6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.

7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.
- 1-10. Samples, shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to
- RENOVATE DENTAL TO AMBULATORY CARE
Veterans of Affairs Healthcare System
3350 La Jolla Village Drive
San Diego, Ca 92161
- 1-11. At the time of transmittal to the Project Manager, the Contractor shall also send a copy of the complete submittal directly to the Contracting Officer.

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor.

1.2 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - T27-06.....Sieve Analysis of Fine and Coarse Aggregates
 - T96-02 (R2006).....Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - T99-01 (R2004).....The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
 - T104-99 (R2003).....Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
 - T180-01 (R2004).....Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
 - T191-02(R2006).....Density of Soil In-Place by the Sand-Cone Method
- C. American Concrete Institute (ACI):
 - 506.4R-94 (R2004).....Guide for the Evaluation of Shotcrete
- D. American Society for Testing and Materials (ASTM):
 - A325-06.....Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - A370-07.....Definitions for Mechanical Testing of Steel Products
 - A416/A416M-06.....Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
 - A490-06.....Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
 - C31/C31M-06.....Making and Curing Concrete Test Specimens in the Field
 - C33-03.....Concrete Aggregates

C39/C39M-05.....Compressive Strength of Cylindrical Concrete
Specimens

C109/C109M-05.....Compressive Strength of Hydraulic Cement Mortars

C138-07.....Unit Weight, Yield, and Air Content
(Gravimetric) of Concrete

C140-07.....Sampling and Testing Concrete Masonry Units and
Related Units

C143/C143M-05.....Slump of Hydraulic Cement Concrete

C172-07.....Sampling Freshly Mixed Concrete

C173-07.....Air Content of freshly Mixed Concrete by the
Volumetric Method

C330-05.....Lightweight Aggregates for Structural Concrete

C567-05.....Density Structural Lightweight Concrete

C780-07.....Pre-construction and Construction Evaluation of
Mortars for Plain and Reinforced Unit Masonry

C1019-08.....Sampling and Testing Grout

C1064/C1064M-05.....Freshly Mixed Portland Cement Concrete

C1077-06.....Laboratories Testing Concrete and Concrete
Aggregates for Use in Construction and Criteria
for Laboratory Evaluation

C1314-07.....Compressive Strength of Masonry Prisms

D698-07.....Laboratory Compaction Characteristics of Soil
Using Standard Effort

D1143-07.....Piles Under Static Axial Compressive Load

D1188-07.....Bulk Specific Gravity and Density of Compacted
Bituminous Mixtures Using Paraffin-Coated
Specimens

D1556-07.....Density and Unit Weight of Soil in Place by the
Sand-Cone Method

D1557-07.....Laboratory Compaction Characteristics of Soil
Using Modified Effort

D2166-06.....Unconfined Compressive Strength of Cohesive Soil

D2167-94(R2001).....Density and Unit Weight of Soil in Place by the
Rubber Balloon Method

D2216-05.....Laboratory Determination of Water (Moisture)
Content of Soil and Rock by Mass

D2922-05.....Density of soil and Soil-Aggregate in Place by
Nuclear Methods (Shallow Depth)

D2974-07.....Moisture, Ash, and Organic Matter of Peat and
Other Organic Soils

D3666-(2002).....Minimum Requirements for Agencies Testing and
Inspection Bituminous Paving Materials
D3740-07.....Minimum Requirements for Agencies Engaged in the
Testing and Inspecting Road and Paving Material
E94-04.....Radiographic Testing
E164-03.....Ultrasonic Contact Examination of Weldments
E329-07.....Agencies Engaged in Construction Inspection
and/or Testing
E543-06.....Agencies Performing Non-Destructive Testing
E605-93(R2006).....Thickness and Density of Sprayed Fire-Resistive
Material (SFRM) Applied to Structural Members
E709-(2001).....Guide for Magnetic Particle Examination
E1155-96(R2008).....Determining FF Floor Flatness and FL Floor
Levelness Numbers

E. American Welding Society (AWS):

D1.1-07.....Structural Welding Code-Steel

1.3 REQUIREMENTS:

- A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E 329, C 1077, D 3666, D3740, A 880, E 543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by Resident Engineer. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of Resident Engineer to such failure.
- C. Written Reports: Testing laboratory shall submit test reports to Resident Engineer, Contractor, unless other arrangements are agreed to in writing by the Resident Engineer. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to Resident Engineer immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK:

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

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

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D1557.
2. Field density tests utilizing ASTM D1556, or D2167 shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the Resident Engineer before the tests are conducted.
 - a. Building Slab Subgrade: At least one test of subgrade for every 185 m² (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m² (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
 - c. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.

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

3.2 FOUNDATION PILES:

- A. Witness load test procedure for conformance with ASTM D1143 and interpret test data to verify geotechnical recommendations for pile capacity. Submit load test report in accordance with ASTM D1143.
- B. Review Contractor's equipment, methods, and procedures prior to starting any work on site. Provide continuous inspection of pile installation. Maintain a record of all pertinent phases of operation for submittal to Resident Engineer.
- C. Cast-in-Place Concrete Piles: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.

3.3 FOUNDATION CAISSONS:

- A. Concrete Testing: Test concrete including materials for concrete as required in Article, CONCRETE of this section, except make two test cylinders for each day's placement of concrete.
- B. Maintain a record of concrete used in each caisson. Compare records with calculated volumes.
- C. Inspect percussion hole in bottom of each caisson to determine that material is capable of supporting design load.
- D. Inspect sides and bottom of each caisson for compliance with contract documents.
- E. Submit a certified "Caisson Field Record" for each caisson, recording actual elevation at bottom of shaft; final center line location of top; variation of shaft from plumb; results of all tests performed; actual

allowable bearing capacity of bottom; depth of socket into rock; levelness of bottom; seepage of water; still water level (if allowed to flood); variation of shaft (from dimensions shown); location and size of reinforcement, and evidence of seams, voids, or channels below the bottom. Verify the actual bearing capacity of the rock strata by the use of a calibrated penetrometer or other acceptable method.

3.4 CONCRETE:

A. Batch Plant Inspection and Materials Testing:

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

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m³ (50 cubic yards) or less of each concrete type, and at least three cylinders

- for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by Resident Engineer make three cylinders for each 80 m³ (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. Resident Engineer may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
 5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
 6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
 7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
 8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
 9. Verify that specified mixing has been accomplished.
 10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
 - a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
 - b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
 11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs,

- and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
 13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
 14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
 15. Observe preparations for placement of concrete:
 - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
 - b. Inspect preparation of construction, expansion, and isolation joints.
 16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
 17. Observe concrete mixing:
 - a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.
 18. Measure concrete flatwork for levelness and flatness as follows:
 - a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
 - b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
 - c. Provide the Contractor and the Resident Engineer with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
 19. Other inspections:
 - a. Grouting under base plates.
 - b. Grouting anchor bolts and reinforcing steel in hardened concrete.
- C. Laboratory Tests of Field Samples:
1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by Resident Engineer. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.

2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
3. Furnish certified compression test reports (duplicate) to Resident Engineer. In test report, indicate the following information:
 - a. Cylinder identification number and date cast.
 - b. Specific location at which test samples were taken.
 - c. Type of concrete, slump, and percent air.
 - d. Compressive strength of concrete in (psi).
 - e. Weight of lightweight structural concrete in (pounds per cubic feet).
 - f. Weather conditions during placing.
 - g. Temperature of concrete in each test cylinder when test cylinder was molded.
 - h. Maximum and minimum ambient temperature during placing.
 - i. Ambient temperature when concrete sample in test cylinder was taken.
 - j. Date delivered to laboratory and date tested.

3.5 REINFORCEMENT:

- A. Review mill test reports furnished by Contractor.
- B. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).
- C. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.
- D. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.
- E. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.10 SHOTCRETE:

- A. Inspection and Material Testing:
 1. Provide field inspection and testing service as required by Resident Engineer to certify that shotcrete has been applied in accordance with contract documents.
 2. Periodically inspect and test proportioning equipment for accuracy and report deficiencies to Resident Engineer.
 3. Sample and test mix ingredients as necessary to insure compliance with specifications.
 4. Sample and test aggregates daily and as necessary for moisture content. Report instances of excessive moisture to Resident Engineer.
 5. Certify, in duplicate, that ingredients and proportions and amounts of ingredients in shotcrete conform to approved trial mixes.

6. Provide field inspection of the proper size and placement of the reinforcement in the shotcrete.

B. Shotcrete Sampling:

1. Provide a technician at site of placement to perform shotcrete sampling.
2. Take cores in accordance with ACI 506.
3. Insure maintenance of water-cement ratio established by approved trial mix.
4. Verify specified mixing has been accomplished.

C. Laboratory Tests of Field Sample Panels:

1. Compression test core for strength in accordance with ACI 506. For each test series of three cores, test one core at 7 days and one core at 28 days. Use remaining core as a spare to be tested at either 7 or 28 days as required. Compile laboratory test reports as follows: Compressive strength test shall be result of one core, except when one core shows evidence of improper sampling or testing, in which case it shall be discarded and strength of spare core shall be used.
2. Submit certified compression test reports (duplicate) to Resident Engineer. On test report, indicate following information:
 - a. Core identification number and date cast.
 - b. Specific location at which test samples were taken.
 - c. Compressive strength of shotcrete in (psi).
 - d. Weather conditions during placing.
 - e. Temperature of shotcrete in each test core when test core was taken.
 - f. Maximum and minimum ambient temperature during placing.
 - g. Ambient temperature when shotcrete sample was taken.
 - h. Date delivered to laboratory and date tested.

- D. Submit inspection reports certification and instances of noncompliance to Resident Engineer.

3.6 MASONRY:

A. Mortar Tests:

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

B. Grout Tests:

1. Laboratory compressive strength test:
 - a. Comply with ASTM C1019.
 - b. Test one sample at 7 days and 2 samples at 28 days.
 - c. Perform test for each 230 m² (2500 square feet) of masonry.

C. Masonry Unit Tests:

1. Laboratory Compressive Strength Test:
 - a. Comply with ASTM C140.
 - b. Test 3 samples for each 460 m² (5000 square feet) of wall area.

- D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m² (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

3.7 STRUCTURAL STEEL:

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

B. Prefabrication Inspection:

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

C. Fabrication and Erection:

1. Weld Inspection:
 - a. Inspect welding equipment for capacity, maintenance and working condition.
 - b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
 - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
 - d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
 - e. Measure 25 percent of fillet welds.
 - f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
 - 1) 20 percent of all shear plate fillet welds at random, final pass only.

- 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
 - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
 - 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
 - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
 - g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
 - h. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.
 - i. Verify that correction of rejected welds are made in accordance with AWS D1.1.
 - j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:
- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.

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

3.8 STEEL DECKING:

- A. Provide field inspection of welds of metal deck to the supporting steel, and testing services to insure steel decking has been installed in accordance with contract documents and manufacturer's requirements.
- B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS D1.1. Refer to the "Plug Weld Qualification Procedure" in Part 3 "Field Quality Control."
- C. Submit inspection reports, certification, and instances of noncompliance to Resident Engineer.

3.16 SHEAR CONNECTOR STUDS:

- A. Provide field inspection and testing services required by AWS D.1 to insure shear connector studs have been installed in accordance with contract documents.
- B. Tests: Test 20 percent of headed studs for fastening strength in accordance with AWS D1.1.
- C. Submit inspection reports, certification, and instances of noncompliance to Resident Engineer.

3.9 SPRAYED-ON FIREPROOFING:

- A. Provide field inspection and testing services to certify sprayed-on fireproofing has been applied in accordance with contract documents.
- B. Obtain a copy of approved submittals from Resident Engineer.
- C. Use approved installation in test areas as criteria for inspection of work.
- D. Test sprayed-on fireproofing for thickness and density in accordance with ASTM E605.
 - 1. Thickness gauge specified in ASTM E605 may be modified for pole extension so that overhead sprayed material can be reached from floor.
- E. Location of test areas for field tests as follows:
 - 1. Thickness: Select one bay per floor, or one bay for each 930 m² (10,000 square feet) of floor area, whichever provides for greater number of tests. Take thickness determinations from each of following locations: Metal deck, beam, and column.

2. Density: Take density determinations from each floor, or one test from each 930 m² (10,000 square feet) of floor area, whichever provides for greater number of tests, from each of the following areas: Underside of metal deck, beam flanges, and beam web.
- F. Submit inspection reports, certification, and instances of noncompliance to Resident Engineer.

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SECTION 01 51 66

TEMPORARY PARTITIONS

PART 1 GENERAL

1.1 TEMPORARY PARTITIONS

- A. Furnish and install and maintain temporary construction partitions to provide smoke-tight separations between construction areas, the areas that are described in phasing requirements, and adjoining areas.
 - 1. Construct partitions of gypsum board or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of wood or metal steel studs.
 - 2. Extend the partitions through suspended ceilings to floor slab or roof. Seal joints and penetrations.
 - 3. At door openings, install Class C, 3/4-hour rated fire and smoke rated doors with self-closing devices.
- B. Install one-hour or two-hour fire-rated temporary construction partitions as shown on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exists, smoke barriers, vertical shafts and openings enclosures.
- C. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials.
- D. Provide doors with locks or latches, as appropriate, where entry and existing through the partition is required.
- E. When directed by the Architect paint the partition, 2 coats, colors and directed.
- F. Temporary Fire Protection: Within the temporary partitioned space, and until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonable predictable and controllable fire losses. Comply with NFPA 241.

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SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

1.2 QUALITY CONTROL

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

1.3 References

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

33 CFR 328.....Definitions

1.4 SUBMITTALS

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

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

1.5 PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.
- B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the Resident Engineer. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.
 - 1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.

2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
 - a. Box and protect from damage existing trees and shrubs to remain on the construction site.
 - b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
 - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.
 - a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of a local //____// (design year) storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, draining from the surface.
 - b. Reuse or conserve the collected topsoil sediment as directed by the Resident Engineer. Topsoil use and requirements are specified in Section 31 20 00, EARTH MOVING.
 - c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and permanent erosion and sedimentation control features shown on the Environmental Protection Plan. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.
6. Manage borrow areas on and off Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.
7. Manage and control spoil areas on and off Government property to limit spoil to areas shown on the Environmental

Protection Plan and prevent erosion of soil or sediment from entering nearby water courses or lakes.

8. Protect adjacent areas from despoilment by temporary excavations and embankments.
 9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
 10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 11. Handle discarded materials other than those included in the solid waste category as directed by the Resident Engineer.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
 2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
 3. Monitor water areas affected by construction.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list species that require specific attention along with measures for their protection.
- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of California and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.

2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
 3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
 4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the Resident Engineer. Maintain noise-produced work at or below the decibel levels and within the time periods specified.

1. Perform construction activities involving repetitive, high-level impact noise only between 8:00 a.m. and 6:00 p.m unless otherwise permitted by local ordinance or the Resident Engineer. Repetitive impact noise on the property shall not exceed the following dB limitations:

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

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

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

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

- b. Use shields or other physical barriers to restrict noise transmission.
- c. Provide soundproof housings or enclosures for noise-producing machinery.

- d. Use efficient silencers on equipment air intakes.
 - e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
 - f. Line hoppers and storage bins with sound deadening material.
 - g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the Resident Engineer 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 Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the Resident Engineer. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 RELATED WORK:

- A. 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. Infectious Control: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7, INFECTION PREVENTION MEASURES.

1.3 PROTECTION:

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.
- E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.

- F. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center; any damaged items shall be repaired or replaced as approved by the Resident Engineer. 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 Resident Engineer's approval.
- G. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.

1.4 TEMPORARY PARTITIONS

- A. furnish and install and maintain temporary construction partitions to provide smoke-tight separations between construction areas, the areas that are described in phasing requirements, and adjoining areas.
 - 1. Construct partitions of type X gypsum board. Provide solid partitions where the fire rating requires them.
 - 2. Extend the partitions through suspended ceilings to floor slab or roof. Seal joints and firestop penetrations.
 - 3. At door openings, install steel fire rated and smoke rated doors with self-closing devices in accordance with Steel Door Institute (SDI) requirements.
- B. Install two-hour fire-rated temporary construction partitions as called for on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures for hazardous areas, horizontal exists, smoke barriers, vertical shafts and openings enclosures.
- C. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with UL listed through-penetration firestop materials.
- D. Provide doors with locks or latches, as appropriate, where entry and exiting through the partition is required.
- E. Paint the partitions 2 coats, colors as selected by the Project Engineer.

1.5 TEMPORARY FIRE PROTECTION

- A. Within the temporary partitioned space, and until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection equipment of types needed to protect the Hospital against all reasonable, predictable and controllable fire losses.

- B. Comply with NFPA 241.
- C. Locate fire extinguishers where directed by the Hospital fire safety authority.

PART 2 - PRODUCTS - INTENTIONALLY NOT USED

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Debris materials shall become property of contractor and shall be disposed of by him, off the Project Site. Disposal shall conform to all local, state, and federal laws and regulations.
- B. On completion of work of this section and after removal of all debris, site shall be left in clean conditions satisfactory to project engineer. Clean-up shall include off the Project Site 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 02 82 13.18

GLOVEBAG ASBESTOS ABATEMENT

PART 1 - GENERAL

1.1 SUMMARY OF THE WORK

1.1.1 CONTRACT DOCUMENTS AND RELATED REQUIREMENTS

Drawings, general provisions of the contract, including general and supplementary conditions and other Division 01 specifications, shall apply to the work of this section. The contract documents show the work to be done under the contract and related requirements and conditions impacting the project. Related requirements and conditions include applicable codes and regulations, notices and permits, existing site conditions and restrictions on use of the site, requirements for partial owner occupancy during the work, coordination with other work and the phasing of the work. In the event the Asbestos Abatement Contractor (Contractor) discovers a conflict in the contract documents and/or requirements or codes, the conflict must be brought to the immediate attention of the Contracting Officer for resolution. Whenever there is a conflict or overlap in the requirements, the most stringent shall apply. Any actions taken by the Contractor without obtaining guidance from the Contracting Officer shall become the sole risk and responsibility of the Contractor. All cost incurred due to such action are also the responsibility of the Contractor.

1.1.2 TASKS

The work tasks are summarized briefly as follows:

- A. Pre-abatement activities including pre-abatement meeting(s), inspection(s), notifications, permits, submittal approvals, work-site preparations, emergency procedures arrangements, and standard operating procedures for glovebag asbestos abatement work.
- B. Abatement activities including removal, clean-up and disposal of ACM waste, recordkeeping, security, monitoring, and inspections.
- C. Cleaning and decontamination activities including final visual inspection, air monitoring and certification of decontamination.

1.1.3 ABATEMENT CONTRACTOR USE OF PREMISES

- A. The Contractor and Contractor's personnel shall cooperate fully with the VA representative/consultant to facilitate efficient use of buildings and areas within buildings. The Contractor shall perform the work in accordance with the VA specifications, drawings, phasing plan and in compliance with any/all applicable Federal, State, and Local regulations and requirements.
- B. The Contractor shall use the existing facilities in the building strictly within the limits indicated in contract documents as well as the approved pre-abatement work plan. Asbestos abatement drawings of partially occupied buildings will show the limits of regulated areas; the placement of decontamination facilities; the temporary location of bagged waste ACM; the path of transport to outside the building; and the temporary waste storage area for each building/regulated area. Any variation from the arrangements shown on drawings shall be secured in writing from the VA

representative through the pre-abatement plan of action. The following limitations of use shall apply to existing facilities shown on drawings:

1.2 VARIATIONS IN QUANTITY

The quantities and locations of ACM as indicated on the drawings and the extent of work included in this section are only estimates which are limited by the physical constraints imposed by occupancy of the buildings. Accordingly, minor variations (+/- 5%) in quantities of ACM within the regulated area are considered as having no impact on contract price and time requirements of this contract. Where additional work is required beyond the above variation, the Contractor shall provide unit prices for additional footage for newly discovered materials and those prices will be used for additional work under the contract.

1.3 STOP ASBESTOS REMOVAL

If the Contracting Officer or their field representative presents a written **Stop Asbestos Removal Order**, the Abatement Contractor/Personnel shall immediately stop all asbestos removal and adequately wet any exposed ACM. The Contractor shall not resume any asbestos removal activity until authorized to do so by the VA. A stop asbestos removal order may be issued at any time the VA determines abatement conditions/activities are not within specification requirements. Work stoppage will continue until conditions have been corrected to the satisfaction of the VA. Standby time and costs for corrective actions will be borne by the Contractor, including the industrial hygienist's time. The occurrence of any of the following events shall be reported immediately by the Contractor in writing to the VA representative and shall require the Contractor to immediately stop asbestos removal activities and initiate fiber reduction activities:

- A. => 0.01 f/cc outside a regulated area or >0.05 f/cc inside a regulated area;
- B. breach/break in regulated area critical barrier(s)/floor;
- C. serious injury/death at the site;
- D. fire/safety emergency at the site;
- E. respiratory protection system failure;
- F. power failure or loss of wetting agent; or
- G. any visible emissions observed outside the regulated area.

1.4 DEFINITIONS

1.4.1 GENERAL

Definitions and explanations here are neither complete nor exclusive of all terms used in the contract documents, but are general for the work to the extent they are not stated more explicitly in another element of the contract documents. Drawings must be recognized as diagrammatic in nature and not completely descriptive of the requirements indicated therein.

1.4.2 GLOSSARY

Abatement - Procedures to control fiber release from asbestos-containing materials, typically during removal. Includes removal, encapsulation, enclosure, demolition and renovation activities related to asbestos.

ACE - Asbestos contaminated elements.

ACM - Asbestos containing material.

Aerosol - Solid or liquid particulate suspended in air.

Adequately wet - Sufficiently mixed or penetrated with liquid to prevent the release of particulates. If visible emissions are observed coming from the ACM, then that material has not been adequately wetted.

Aggressive method - Removal or disturbance of building material by sanding, abrading, grinding, or other method that breaks, crumbles, or disintegrates intact ACM.

Aggressive sampling - EPA AHERA defined clearance sampling method using air moving equipment such as fans and leaf blowers to aggressively disturb and maintain in the air residual fibers after abatement.

AHERA - Asbestos Hazard Emergency Response Act. Asbestos regulations for schools issued in 1987.

Aircell - Pipe or duct insulation made of corrugated cardboard which contains asbestos.

Air monitoring - The process of measuring the fiber content of a known volume of air collected over a specified period of time. The NIOSH 7400 Method, Issue 2 is used to determine the fiber levels in air.

Air sample filter - The filter used to collect fibers which are then counted. The filter is made of mixed cellulose ester membrane for PCM (Phase Contrast Microscopy) and polycarbonate for TEM (Transmission Electron Microscopy)

Amended water - Water to which a surfactant (wetting agent) has been added to increase the penetrating ability of the liquid.

Asbestos - Includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated or altered. Asbestos also includes PACM, as defined below.

Asbestos-containing material (ACM) - Any material containing more than one percent asbestos.

Asbestos contaminated elements (ACE) - Building elements such as ceilings, walls, lights, or ductwork that are contaminated with asbestos.

Asbestos-containing waste material - Asbestos-containing material or asbestos contaminated objects requiring disposal.

Asbestos waste decontamination facility - A system consisting of drum/bag washing facilities and a temporary storage area for cleaned containers of asbestos waste. Used as the exit for waste and equipment

leaving the regulated area. In an emergency, it may be used to evacuate personnel.

Authorized person - Any person authorized by the VA, the Contractor, or government agency and required by work duties to be present in regulated areas.

Authorized visitor - Any person approved by the VA; the contractor; or any government agency having jurisdiction over the regulated area.

Barrier - Any surface that isolates the regulated area and inhibits fiber migration from the regulated area.

Containment Barrier - An airtight barrier consisting of walls, floors, and/or ceilings of sealed plastic sheeting which surrounds and seals the outer perimeter of the regulated area.

Critical Barrier - The barrier responsible for isolating the regulated area from adjacent spaces, typically constructed of plastic sheeting secured in place at openings such as doors, windows, or any other opening into the regulated area.

Primary Barrier - Barriers placed over critical barriers and exposed directly to abatement work.

Secondary Barrier - Any additional sheeting used to isolate and provide protection from debris during abatement work.

Breathing zone - The hemisphere forward of the shoulders with a radius of about 150 - 225 mm (6 - 9 inches) from the worker's nose.

Bridging encapsulant - An encapsulant that forms a layer on the surface of the ACM.

Building/facility owner - The legal entity, including a lessee, which exercises control over management and recordkeeping functions relating to a building and/or facility in which asbestos activities take place.

Bulk testing - The collection and analysis of suspect asbestos containing materials.

Certified Industrial Hygienist (CIH) - One certified in practice of industrial hygiene by the American Board of Industrial Hygiene. An industrial hygienist Certified in Comprehensive Practice by the American Board of Industrial Hygiene.

Class I asbestos work - Activities involving the removal of Thermal System Insulation (TSI) and surfacing ACM and Presumed Asbestos Containing Material (PACM).

Class II asbestos work - Activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic.

Clean room/Changing room - An uncontaminated room having facilities for the storage of employee's street clothing and uncontaminated materials and equipment.

Clearance sample - The final air sample taken after all asbestos work has been done and visually inspected. Performed by the VA's industrial hygiene consultant (VPIH/CIH).

Closely resemble - The major workplace conditions which have contributed to the levels of historic asbestos exposure, are no more protective than conditions of the current workplace.

Competent person - In addition to the definition in 29 CFR 1926.32(f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f); in addition, for Class I and II work who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan (40 CFR 763) for supervisor.

Contractor's Professional Industrial Hygienist (CPIH) - The Contractor's industrial hygienist. The industrial hygienist must meet the qualification requirements of the PIH.

Count - Refers to the fiber count or the average number of fibers greater than five microns in length per cubic centimeter of air.

Decontamination area/unit - An enclosed area adjacent to and connected to the regulated area and consisting of an equipment room, shower room, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

Demolition - The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

Disposal bag - Typically 6 mil thick siftproof, dustproof, leaktight container used to package and transport asbestos waste from regulated areas to the approved landfill. Each bag/container must be labeled/marked in accordance with EPA, OSHA and DOT requirements.

Disturbance - Activities that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. Disturbance includes cutting away small amounts of ACM or PACM, no greater than the amount that can be contained in one standard sized glove bag or waste bag in order to access a building component. In no event shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or disposal bag which shall not exceed 60 inches in length or width.

Drum - A rigid, impermeable container made of cardboard fiber, plastic, or metal which can be sealed in order to be siftproof, dustproof, and leaktight.

Employee exposure - The exposure to airborne asbestos that would occur if the employee were not wearing respiratory protection equipment.

Encapsulant - A material that surrounds or embeds asbestos fibers in an adhesive matrix and prevents the release of fibers.

Encapsulation - Treating ACM with an encapsulant.

Enclosure - The construction of an air tight, impermeable, permanent barrier around ACM to control the release of asbestos fibers from the material and also eliminate access to the material.

Equipment room - A contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

Fiber - A particulate form of asbestos, 5 microns or longer, with a length to width ratio of at least 3 to 1.

Fibers per cubic centimeter (f/cc) - Abbreviation for fibers per cubic centimeter, used to describe the level of asbestos fibers in air.

Filter - Media used in respirators, vacuums, or other machines to remove particulate from air.

Firestopping - Material used to close the open parts of a structure in order to prevent a fire from spreading.

Friable asbestos containing material - Any material containing more than 1 percent asbestos as determined using the method specified in appendix A, Subpart F, 40 CFR 763, section 1, Polarized Light Microscopy, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

Glovebag - Not more than a 60 x 60 inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which materials and tools may be handled.

High efficiency particulate air (HEPA) filter - A filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 microns or greater in diameter.

HEPA vacuum - Vacuum collection equipment equipped with a HEPA filter system capable of collecting and retaining asbestos fibers.

Homogeneous area - An area of surfacing, thermal system insulation or miscellaneous ACM that is uniform in color, texture and date of application.

HVAC - Heating, Ventilation and Air Conditioning

Industrial hygienist - A professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards. Meets definition requirements of the American Industrial Hygiene Association (AIHA).

Industrial hygienist technician - A person working under the direction of an IH or CIH who has special training, experience, certifications and licenses required for the industrial hygiene work assigned.

Intact - The ACM has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.

Lockdown - Applying encapsulant, after a final visual inspection, on all abated surfaces at the conclusion of ACM removal prior to removal of critical barriers.

National Emission Standards for Hazardous Air Pollutants (NESHAP's) - EPA's rule to control emissions of asbestos to the environment.

Negative initial exposure assessment - A demonstration by the employer which complies with the criteria in 29 CFR 1926.1101 (f)(2)(iii), that employee exposure during an operation is expected to be consistently below the PEL's.

Negative pressure - Air pressure which is lower than the surrounding area, created by exhausting air from a sealed regulated area through HEPA equipped filtration units. OSHA requires maintaining -0.02" water gauge inside the negative pressure enclosure.

Negative pressure respirator - A respirator in which the air pressure inside the facepiece is negative during inhalation relative to the air outside the respirator.

Non-friable ACM - Material that contains more than 1 percent asbestos but cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Organic vapor cartridge - The type of cartridge used on air purifying respirators for organic vapor exposures.

Outside air - The air outside buildings and structures, including, but not limited to, the air under a bridge or in an open ferry dock.

Owner/operator - Any person who owns, leases, operates, controls, or supervises the facility being demolished or renovated or any person who owns, leases, operates, controls, or supervises the demolition or renovation operation, or both.

Penetrating encapsulant - Encapsulant that is absorbed into the ACM matrix without leaving a surface layer.

Personal sampling/monitoring - Representative air samples obtained in the breathing zone of the person using a cassette and battery operated pump to determine asbestos exposure.

Permissible exposure limit (PEL) - The level of exposure OSHA allows for an 8 hour time weighted average. For asbestos fibers, the PEL is 0.1 fibers per cc.

Polarized light microscopy (PLM) - Light microscopy using dispersion staining techniques and refractive indices to identify and quantify the type(s) of asbestos present in a bulk sample.

Polyethylene sheeting - Strong plastic barrier material 4 to 6 mils thick, semi-transparent, sometimes flame retardant in compliance with NFPA 241.

Positive/negative fit check - A method of verifying the fit of a respirator by closing off the filters and breathing in or closing off the exhalation valve and breathing out while detecting leakage of the respirator.

Presumed ACM (PACM) - Thermal system insulation, surfacing, and flooring material installed in buildings prior to 1981. If the building owner has actual knowledge, or should have known through the exercise of due diligence that other materials are ACM, they too must be treated as

PACM. The designation of PACM may be rebutted pursuant to 29 CFR 1926.1101 (k)(5).

Professional IH - An IH who meets the definition requirements of AIHA; meets the definition requirements of OSHA as a "Competent Person" at 29 CFR 1926.1101 (b); has completed two specialized EPA approved courses on management and supervision of asbestos abatement projects; has formal training in respiratory protection and waste disposal; and has a minimum of four projects of similar complexity with this project of which at least three projects serving as the supervisory IH.

Project designer - A person who has successfully completed the training requirements for an asbestos abatement project designer as required by 40 CFR 763 Appendix C, Part I; (B)(5).

Protection factor - A value assigned by OSHA/NIOSH to indicate the assigned protection a respirator should provide if worn properly. The number indicates the reduction of exposure level from outside to inside the respirator.

Qualitative fit test (QLFT) - A fit test using a challenge material that can be sensed by the wearer if leakage in the respirator occurs.

Quantitative fit test (QNFT) - A fit test using a challenge material which is quantified outside and inside the respirator thus allowing the determination of the actual fit factor.

Regulated area - An area established by the employer to demarcate where Class I, II, III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work may accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed the PEL.

Regulated ACM (RACM) - Friable ACM; Category I nonfriable ACM that has become friable; Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading or; Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of the demolition or renovation operation.

Removal - All operations where ACM, PACM and/or RACM is taken out or stripped from structures or substrates, including demolition operations.

Renovation - Altering a facility or one or more facility components in any way, including the stripping or removal of asbestos from a facility component which does not involve demolition activity.

Repair - Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM or PACM attached to structures or substrates.

Shower room - The portion of the PDF where personnel shower before leaving the regulated area. Also used for bag/drum decontamination in the EDF.

Standard operating procedures (SOP's) - Asbestos work procedures required to be submitted by the contractor before work begins.

Supplied air respirator (SAR) - A respirator that utilizes an air supply separate from the air in the regulated area.

Surfacing ACM - A material containing more than 1 percent asbestos that is sprayed, troweled on or otherwise applied to surfaces for acoustical, fireproofing and other purposes.

Surfactant - A chemical added to water to decrease water's surface tension thus making it more penetrating into ACM.

Thermal system ACM - A material containing more than 1 percent asbestos applied to pipes, fittings, boilers, breeching, tanks, ducts, or other structural components to prevent heat loss or gain.

Transmission electron microscopy (TEM) - A microscopy method that can identify and count asbestos fibers.

VA Industrial Hygienist (VPIH/CIH) - Department of Veterans Affairs Professional Industrial Hygienist.

VA Representative - The VA official responsible for on-going project work.

Visible emissions - Any emissions, which are visually detectable without the aid of instruments, coming from ACM/PACM/RACM or ACM waste material.

Waste generator - Any owner or operator whose act or process produces asbestos-containing waste material.

Waste/Equipment decontamination facility (W/EDF) - The area in which equipment is decontaminated before removal from the regulated area.

Waste shipment record - The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of asbestos-containing waste material.

Wet cleaning - The process of thoroughly eliminating, by wet methods, any asbestos contamination from surfaces or objects.

1.4.3 REFERENCED STANDARDS ORGANIZATIONS

The following acronyms or abbreviations as referenced in contract/specification documents are defined to mean the associated names. Names and addresses may be subject to change.

- A. VA Department of Veterans Affairs
810 Vermont Avenue, NW
Washington, DC 20420
- B. AIHA American Industrial Hygiene Association
2700 Prosperity Avenue, Suite 250
Fairfax, VA 22031
703-849-8888
- C. ANSI American National Standards Institute
1430 Broadway
New York, NY 10018
212-354-3300
- D. ASTM American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103
215-299-5400

- E. CFR Code of Federal Regulations
Government Printing Office
Washington, DC 20420
- F. CGA Compressed Gas Association
1235 Jefferson Davis Highway
Arlington, VA 22202
703-979-0900
- G. CS Commercial Standard of the National Institute of Standards and Technology(NIST)
U. S. Department of Commerce
Government Printing Office
Washington, DC 20420
- H. EPA Environmental Protection Agency
401 M St., SW
Washington, DC 20460
202-382-3949
- I. MIL-STD Military Standards/Standardization Division
Office of the Assistant Secretary of Defense

Washington, DC 20420
- J. MSHA Mine Safety and Health Administration

Respiratory Protection Division
Ballston Tower #3
Department of Labor
Arlington, VA 22203
703-235-1452
- K. NIST National Institute for Standards and Technology
U. S. Department of Commerce
Gaithersburg, MD 20234
301-921-1000
- L. NEC National Electrical Code (by NFPA)
- M. NEMA National Electrical Manufacturer's Association
2101 L Street, NW
Washington, DC 20037
- N. NFPA National Fire Protection Association
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
800-344-3555
- O. NIOSH National Institutes for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, OH 45226
513-533-8236
- P. OSHA Occupational Safety and Health Administration
U.S. Department of Labor
Government Printing Office
Washington, DC 20402
- Q. UL Underwriters Laboratory
333 Pfingsten Rd.

Northbrook, IL 60062
312-272-8800

- R. USA United States Army
Army Chemical Corps
Department of Defense
Washington, DC 20420

1.5 APPLICABLE CODES AND REGULATIONS

1.5.1 GENERAL APPLICABILITY OF CODES, REGULATIONS, AND STANDARDS

- A. All work under this contract shall be done in strict accordance with all applicable Federal, State, and local regulations, standards and codes governing asbestos abatement, and any other trade work done in conjunction with the abatement. All applicable codes, regulations and standards are adopted into this specification and will have the same force and effect as this specification.
- B. The most recent edition of any relevant regulation, standard, document or code shall be in effect. Where conflict among the requirements or with these specification exists, the most stringent requirement(s) shall be utilized.
- C. Copies of all standards, regulations, codes and other applicable documents, including this specification and those listed in Section 1.5 shall be available at the worksite in the clean change area of the worker decontamination system.

1.5.2 CONTRACTOR RESPONSIBILITY

The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State and Local regulations related to any and all aspects of the abatement project. The contractor is responsible for providing and maintaining training, accreditation, medical exams, medical records, personal protective equipment as required by applicable Federal, State and Local regulations. The contractor shall hold the VA and VPIH/CIH consultants harmless for any failure to comply with any applicable work, packaging, transporting, disposal, safety, health, or environmental requirement on the part of himself, his employees, or his subcontractors. The contractor will incur all costs of the CPIH, including all sampling/analytical costs to assure compliance with OSHA/EPA/State requirements.

1.5.3 FEDERAL REQUIREMENTS

Federal requirements which govern some aspect of asbestos abatement include, but are not limited to, the following regulations.

- A. Occupational Safety and Health Administration (OSHA)
1. Title 29 CFR 1926.1101 - Construction Standard for Asbestos
 2. Title 29 CFR 1910.132 - Personal Protective Equipment
 3. Title 29 CFR 1910.134 - Respiratory Protection
 4. Title 29 CFR 1926 - Construction Industry Standards
 5. Title 29 CFR 1910.20 - Access to Employee Exposure and Medical Records

- 6. Title 29 CFR 1910.1200 - Hazard Communication
- 7. Title 29 CFR 1910.151 - Medical and First Aid
- B. Environmental Protection Agency (**EPA**)
 - 1. 40 CFR 61 Subpart A and M (Revised Subpart B) - National Emission Standard for Hazardous Air Pollutants - Asbestos.
 - 2. 40 CFR 763.80 - Asbestos Hazard Emergency Response Act (AHERA)
- C. Department of Transportation (**DOT**)
 - Title 49 CFR 100 - 185 - Transportation

1.5.4 STANDARDS

- A. Standards which govern asbestos abatement activities include, but are not limited to, the following:
 - 1. American National Standards Institute (ANSI) Z9.2-79 - Fundamentals Governing the Design and Operation of Local Exhaust Systems Z88.2 - Practices for Respiratory Protection.
 - 2. Underwriters Laboratories (UL) 586-90 - UL Standard for Safety of HEPA filter Units, 7th Edition.
- B. Standards which govern encapsulation work include, but are not limited to, the following:
 - 1. American Society for Testing and Materials (ASTM)
- C. Standards which govern the fire and safety concerns in abatement work include, but are not limited to, the following:
 - 1. National Fire Protection Association (NFPA) 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.
 - 2. NFPA 701 - Standard Methods for Fire Tests for Flame Resistant Textiles and Film.
 - 3. NFPA 101 - Life Safety Code

1.5.5 EPA GUIDANCE DOCUMENTS

- A. EPA guidance documents which discuss asbestos abatement work activities are listed below. These documents are made part of this section by reference. EPA publications can be ordered from (800) 424-9065.
- B. Guidance for Controlling ACM in Buildings (Purple Book) EPA 560/5-85-024
- C. Asbestos Waste Management Guidance EPA 530-SW-85-007.
- D. A Guide to Respiratory Protection for the Asbestos Abatement Industry EPA-560-OPTS-86-001

- E. Guide to Managing Asbestos in Place (Green Book) TS 799 20T July 1990

1.5.6 NOTICES

- A. State and Local agencies: Send written notification as required by state and local regulations including the local fire department prior to beginning any work on ACM as follows:
- B. Copies of notifications shall be submitted to the VA for the facility's records in the same time frame notification is given to EPA, State, and Local authorities.

1.5.7 PERMITS/LICENSES

The contractor shall apply for and have all required permits and licenses to perform asbestos abatement work as required by Federal, State, and Local regulations.

1.5.8 POSTING AND FILING OF REGULATIONS

Maintain two (2) copies of applicable federal, state, and local regulations. Post one copy of each at the regulated area where workers will have daily access to the regulations and keep another copy in the Contractor's office.

1.5.9 VA RESPONSIBILITIES

Prior to commencement of work:

- A. Notify occupants adjacent to regulated areas of project dates and requirements for relocation, if needed. Arrangements must be made prior to starting work for relocation of desks, files, equipment and personal possessions to avoid unauthorized access into the regulated area. **Note: Notification of adjacent personnel is required by OSHA in 29 CFR 1926.1101 (k) to prevent unnecessary or unauthorized access to the regulated area.**
- B. Submit to the Contractor results of background air sampling; including location of samples, person who collected the samples, equipment utilized and method of analysis.
- C. During abatement, submit to the Contractor, results of bulk material analysis and air sampling data collected during the course of the abatement. This information shall not release the Contractor from any responsibility for OSHA compliance.

1.5.10 SITE SECURITY

- A. Regulated area access is to be restricted only to authorized, trained/accredited and protected personnel. These may include the Contractor's employees, employees of Subcontractors, VA employees and representatives, State and local inspectors, and any other designated individuals. A list of authorized personnel shall be established prior to commencing the project and be posted in the clean room of the decontamination unit.
- B. Entry into the regulated area by unauthorized individuals shall be reported immediately to the Competent Person by anyone observing the entry. The Competent Person shall immediately notify the VA.

- C. A log book shall be maintained in the clean room of the decontamination unit. Anyone who enters the regulated area must record their name, affiliation, time in, and time out for each entry.
- D. Access to the regulated area shall be through a single decontamination unit, if required. All other access (doors, windows, hallways, etc.) shall be sealed or locked to prevent entry to or exit from the regulated area. The only exceptions for this requirement are the waste/equipment load-out area which shall be sealed except during the removal of containerized asbestos waste from the regulated area, and emergency exits. Emergency exits shall not be locked from the inside, however, they shall be sealed with poly sheeting and taped until needed.
- E. The Contractor's Competent Person shall control site security during abatement operations in order to isolate work in progress and protect adjacent personnel. A 24 hour security system shall be provided at the entrance to the regulated area to assure that all entrants are logged in/out and that only authorized personnel are allowed entrance.
- F. The Abatement Contractor will have the VA's assistance in notifying adjacent personnel of the presence, location and quantity of ACM in the regulated area and enforcement of restricted access by the VA's employees.
- G. The regulated area shall be locked during non-working hours and secured by VA security guards.

1.5.11 EMERGENCY ACTION PLAN AND ARRANGEMENTS

- A. An Emergency Action Plan shall be developed by the Contractor prior to commencing abatement activities and shall be agreed to by the Contractor and the VA. The Plan shall meet the requirements of 29 CFR 1910.38 (a);(b).
- B. Emergency procedures shall be in written form and prominently posted and available in the regulated area. Everyone, prior to entering the regulated area, must read and sign these procedures to acknowledge understanding of the regulated area layout, location of emergency exits and emergency procedures.
- C. Emergency planning shall include written notification of police, fire, and emergency medical personnel of planned abatement activities; work schedule and layout of regulated area, particularly barriers that may affect response capabilities.
- D. Emergency planning shall include consideration of fire, explosion, hazardous atmospheres, electrical hazards, slips/trips and falls, confined spaces, and heat stress illness. Written procedures for response to emergency situations shall be developed and employee training in procedures shall be provided.
- E. Employees shall be trained in regulated area/site evacuation procedures in the event of workplace emergencies.
 - 1. For non life-threatening situations - employees injured or otherwise incapacitated shall decontaminate following normal procedures with assistance from fellow workers, if necessary, before exiting the regulated area to obtain proper medical treatment.

2. For life-threatening injury or illness, worker decontamination shall take least priority after measures to stabilize the injured worker, remove them from the regulated area, and secure proper medical treatment.
- F. Telephone numbers of all emergency response personnel shall be prominently posted in the clean room, along with the location of the nearest telephone.
- G. The Contractor shall provide verification of first aid/CPR training for personnel responsible for providing first aid/CPR. OSHA requires medical assistance within 3 minutes of a life-threatening injury/illness. Bloodborne Pathogen training shall also be verified for those personnel required to provide first aid/CPR.
- H. The Emergency Action Plan shall provide for a Contingency Plan in the event that an incident occurs that may require the modification of the standard operating procedures during abatement. Such incidents include, but are not limited to, fire; accident; and power failure. The Contractor shall detail procedures to be followed in the event of an incident assuring that work is stopped and wetting is continued until correction of the problem.

1.5.12 PRE-CONSTRUCTION MEETING

Prior to commencing the work, the Contractor shall meet with the VPCIH to present and review, as appropriate, the items following this paragraph. The Contractor's Competent Person(s) who will be on-site shall participate in the pre-start meeting. The pre-start meeting is to discuss and determine procedures to be used during the project. At this meeting, the Contractor shall provide:

- A. Proof of Contractor licensing.
- B. Proof the Competent Person is trained and accredited and approved for working in this State. Verification of the experience of the Competent Person shall also be presented.
- C. A list of all workers who will participate in the project, including experience and verification of training and accreditation.
- D. A list of and verification of training for all personnel who have current first-aid/CPR training. A minimum of one person per shift must have adequate training.
- E. Current medical written opinions for all personnel working on-site meeting the requirements of 29 CFR 1926.1101 (m).
- F. Current fit-tests for all personnel wearing respirators on-site meeting the requirements of 29 CFR 1926.1101 (h) and Appendix C.
- G. A copy of the Contractor's Standard Operating Procedures for Class I Glovebag Asbestos Abatement. In these procedures, the following information must be detailed, specific for this project.

1. Regulated area preparation procedures;

2. Notification requirements procedure of Contractor as required in 29 CFR 1926.1101 (d);
3. If required, decontamination area set-up/layout and decontamination procedures for employees;
4. Glovebag abatement methods/procedures and equipment to be used;
5. Personal protective equipment to be used;
- H. At this meeting the Contractor shall provide all submittals as required.
- I. Procedures for handling, packaging and disposal of asbestos waste.
- J. Emergency Action Plan and Contingency Plan Procedures.

1.6 PROJECT COORDINATION

The following are the minimum administrative and supervisory personnel necessary for coordination of the work.

1.6.1 PERSONNEL

- A. Administrative and supervisory personnel shall consist of a qualified Competent Person as defined by OSHA in the Construction Standards and the Asbestos Construction Standard; Contractor Professional Industrial Hygienist and Industrial Hygiene Technicians. These employees are the Contractor's representatives responsible for compliance with these specifications and all other applicable requirements.
- B. Non-supervisory personnel shall consist of an adequate number of qualified personnel to meet the schedule requirements of the project. Personnel shall meet required qualifications. Personnel utilized on-site shall be pre-approved by the VA representative. A request for approval shall be submitted for any person to be employed during the project giving the person's name; social security number; qualifications; accreditation card with picture; Certificate of Worker's Acknowledgment; and Affidavit of Medical Surveillance and Respiratory Protection and current Respirator Fit Test.
- C. Minimum qualifications for Contractor and assigned personnel are:
 1. The Contractor has conducted within the last three (3) years, three (3) projects of similar complexity and dollar value as this project; has not been cited and penalized for serious violations of asbestos regulations in the past three (3) years; has adequate liability/occurrence insurance for asbestos work; is licensed in applicable states; has adequate and qualified personnel available to complete the work; has comprehensive standard operating procedures for asbestos work; has adequate materials, equipment and supplies to perform the work.
 2. The Competent Person has four (4) years of abatement experience of which two (2) years were as the Competent Person on the project; meets the OSHA definition of a Competent Person; has been the Competent Person on two (2) projects of similar size and complexity as this project; has completed EPA AHERA/OSHA/State/Local training

requirements/accreditation(s) and refreshers; and has all required OSHA documentation related to medical and respiratory protection.

3. The Contractor Professional Industrial Hygienist (CPIH) shall have five (5) years of monitoring experience and supervision of asbestos abatement projects; has participated as senior IH on five (5) abatement projects, three (3) of which are similar in size and complexity as this project; has developed at least one complete standard operating procedure for asbestos abatement; has trained abatement personnel for three (3) years; has specialized EPA AHERA/OSHA training in asbestos abatement management, respiratory protection, waste disposal and asbestos inspection; has completed the NIOSH 582 Course, Contractor/Supervisor course; and has appropriate medical/respiratory protection records/documentation.
4. The Abatement Personnel shall have completed the EPA AHERA/OSHA abatement worker course; have training on the standard operating procedures of the Contractor; has one year of asbestos abatement experience; has applicable medical and respiratory protection documentation; has certificate of training/current refresher and State accreditation/license.

1.7 RESPIRATORY PROTECTION

1.7.1 GENERAL - RESPIRATORY PROTECTION PROGRAM

The Contractor shall develop and implement a Respiratory Protection Program (RPP) which is in compliance with the January 8, 1998 OSHA requirements found at 29 CFR 1926.1101 and 29 CFR 1910.132;134. ANSI Standard Z88.2-1992 provides excellent guidance for developing a respiratory protection program All respirators used must be NIOSH approved for asbestos abatement activities. The written respiratory protection shall, at a minimum, contain the basic requirements found at 29 CFR 1910.134 (c)(1)(i - ix) - Respiratory Protection Program.

1.7.2 RESPIRATORY PROTECTION PROGRAM COORDINATOR

The Respiratory Protection Program Coordinator (RPPC) must be identified and shall have two (2) years experience coordinating the program. The RPPC must provide a signed statement attesting to the fact that the program meets the above requirements.

1.7.3 SELECTION AND USE OF RESPIRATORS

The procedure for the selection and use of respirators must be submitted to the VA as part of the Contractor's qualification. The procedure must be written clearly enough for workers to understand. A copy of the Respiratory Protection Program must be available in the clean room of the decontamination unit for reference by employees or authorized visitors.

1.7.4 MINIMUM RESPIRATORY PROTECTION

Minimum respiratory protection shall be a full face powered air purifying respirator when fiber levels are maintained consistently at or below 0.5 f/cc. A higher level of respiratory protection may be provided or required, depending on fiber levels. Respirator selection shall meet the requirements of 29 CFR 1926.1101 (h); Table 1, except as indicated

in this paragraph. Abatement personnel must have a respirator for their exclusive use.

1.7.5 MEDICAL WRITTEN OPINION

No employee shall be allowed to wear a respirator unless a physician has determined they are capable of doing so and has issued a written opinion for that person.

1.7.6 RESPIRATOR FIT TEST

All personnel wearing respirators shall have a current quantitative fit test which was conducted in accordance with 29 CFR 1910.134 (f) and Appendix A. Fit tests shall be done for PAPR's which have been put into a failure mode.

1.7.7 RESPIRATOR FIT CHECK

The Competent Person shall assure that the positive/negative fit check is done each time the respirator is donned by an employee. Headcoverings must cover respirator headstraps. Any situation that prevents an effective facepiece to face seal as evidenced by failure of a fit check shall preclude that person from wearing a respirator until resolution of the problem.

1.7.8 MAINTENANCE AND CARE OF RESPIRATORS

The Respiratory Protection Program Coordinator shall submit evidence and documentation showing compliance with 29 CFR 1910.134 (h) maintenance and care of respirators.

1.8 WORKER PROTECTION

1.8.1 TRAINING OF ABATEMENT PERSONNEL

Prior to beginning any abatement activity, all personnel shall be trained in accordance with OSHA 29 CFR 1926.1101 (k)(9) and any additional State/Local requirements. Training must include, at a minimum, the elements listed at 29 CFR 1926.1101 (k)(9)(viii). Training shall have been conducted by a third party, EPA/State approved trainer meeting the requirements of EPA 40 CFR 763 Appendix C (AHERA MAP). Initial training certificates and current refresher and accreditation proof must be submitted for each person working at the site.

1.8.2 MEDICAL EXAMINATIONS

Medical examinations meeting the requirements of 29 CFR 1926.1101 (m) shall be provided for all personnel working in the regulated area, regardless of exposure levels. The physician's written opinion as required by 29 CFR 1926.1101 (m)(4) shall be provided for each person and shall include in the opinion the person has been evaluated for working in a heat stress environment while wearing personal protective equipment and is able to perform the work.

1.8.3 PERSONAL PROTECTIVE EQUIPMENT

Provide whole body clothing, head coverings, foot coverings and any other personal protective equipment as determined by conducting the hazard assessment required by OSHA at 29 CFR 1910.132 (d). The Competent Person shall ensure the integrity of personal protective equipment worn

for the duration of the project. Duct tape shall be used to secure all suit sleeves to wrists and to secure foot coverings at the ankle.

1.8.4 REGULATED AREA ENTRY PROCEDURE

Worker protection shall meet the most stringent requirement. The Competent Person shall ensure that each time workers enter the regulated area, they remove ALL street clothes in the clean room of the decontamination unit and put on new disposable coveralls, head coverings, a clean respirator, and then proceed through the shower room to the equipment room where they put on non-disposable required personal protective equipment.

1.8.5 DECONTAMINATION PROCEDURE - PAPR

The Competent Person shall require all personnel to adhere to following decontamination procedures whenever they leave the regulated area.

- A. When exiting the regulated area, remove disposable coveralls, and ALL other clothes, disposable head coverings, and foot coverings or boots in the equipment room.
- B. Still wearing the respirator and completely naked, proceed to the shower. Showering is MANDATORY. Care must be taken to follow reasonable procedures in removing the respirator to avoid asbestos fibers while showering. The following procedure is required as a minimum:
 - 1. Thoroughly wet body including hair and face. If using a PAPR hold blower above head to keep filters dry.
 - 2. With respirator still in place, thoroughly decontaminate body, hair, respirator face piece, and all other parts of the respirator except the blower and battery pack on a PAPR. Pay particular attention to cleaning the seal between the face and respirator facepiece and under the respirator straps.
 - 3. Take a deep breath, hold it and/or exhale slowly, completely wetting hair, face, and respirator. While still holding breath, remove the respirator and hold it away from the face before starting to breathe.
- C. Carefully decontaminate the facepiece of the respirator inside and out. If using a PAPR, shut down using the following sequence: a) first cap inlets to filters; b) turn blower off to keep debris collected on the inlet side of the filter from dislodging and contaminating the outside of the unit; c) thoroughly decontaminate blower and hoses; d) carefully decontaminate battery pack with a wet rag being cautious of getting water in the battery pack thus preventing destruction. **THIS PROCEDURE IS NOT A SUBSTITUTE FOR RESPIRATOR CLEANING!**
- D. Shower and wash body completely with soap and water. Rinse thoroughly.
- E. Rinse shower room walls and floor to drain prior to exiting.
- F. Proceed from shower to clean room; dry off and change into street clothes or into new disposable work clothing.

1.8.6 REGULATED AREA REQUIREMENTS

The Competent Person shall meet all requirements of 29 CFR 1926.1101 (o) and assure that all requirements for Class I glovebag regulated areas at 29 CFR 1926.1101 (e) are met. All personnel in the regulated area shall not be allowed to eat, drink, smoke, chew tobacco or gum, apply cosmetics, or in any way interfere with the fit of their respirator.

1.9 DECONTAMINATION FACILITIES

1.9.1 DESCRIPTION

Provide each regulated area with separate personnel (PDF) and waste/equipment decontamination facilities (W/EDF). Ensure that the PDF is the only means of ingress and egress to the regulated area and that all equipment, bagged waste, and other material exit the regulated area only through the W/EDF.

1.9.2 GENERAL REQUIREMENTS

All personnel entering or exiting a regulated area shall follow the requirements at 29 CFR 1926.1101 (j)(1) and these specifications. All equipment and materials must exit the regulated area through the W/EDF and be decontaminated in accordance with these specifications. Walls and ceilings of the PDF and W/EDF must be constructed of a minimum of 3 layers of 6 mil opaque fire retardant polyethylene sheeting and be securely attached to existing building components and/or an adequate temporary framework. A minimum of 3 layers of 6 mil poly shall also be used to cover the floor under the PDF and W/EDF units. Construct doors so that they overlap and secure to adjacent surfaces. Weigh sheets with layers of duct tape so that they close quickly after release. Put arrows on sheets so they show direction of travel and overlap. If the building adjacent area is occupied, construct a solid barrier on the occupied side(s) to protect the sheeting.

1.9.3 TEMPORARY FACILITIES TO THE PDF AND W/EDF

The Competent Person shall provide temporary water service connections to the PDF and W/EDF. Backflow prevention must be provided at the point of connection to the VA system. Water supply must be of adequate pressure and meet requirements of 29 CFR 1910.141(d)(3). Provide adequate temporary electric power with ground fault protection and overhead wiring in the PDF and W/EDF. Provide a sub-panel for all temporary power in the clean room. Provide adequate lighting to provide a minimum of 50 foot candles in the PDF and W/EDF. Provide temporary heat to maintain 70°F throughout the PDF and W/EDF..

1.9.4 PERSONNEL DECONTAMINATION FACILITY (PDF)

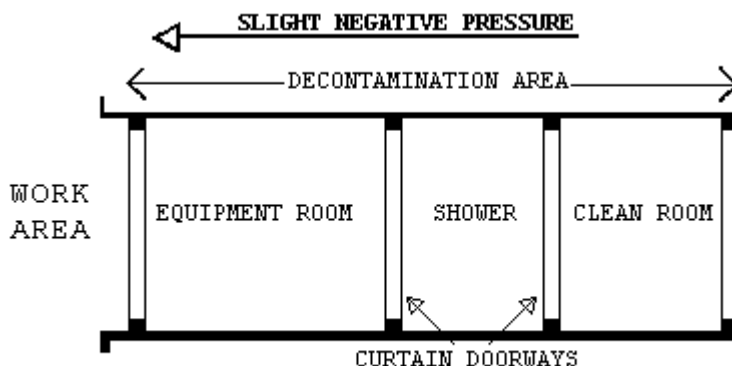
The Competent Person shall provide a PDF consisting of shower room which is contiguous to a clean room and equipment room. The PDF must be sized to accommodate the number of personnel scheduled for the project. The shower room, located in the center of the PDF, shall be fitted with as many portable showers as necessary to ensure all employees can complete the entire decontamination procedure within 15 minutes. The PDF shall be constructed of opaque poly for privacy. The PDF shall be constructed to eliminate any parallel routes of egress without showering.

1. Clean Room: The clean room must be physically and visually separated from the rest of the building to protect the privacy of personnel changing clothes. The clean room shall be constructed of at least 2 layers of 6 mil fire retardant poly to provide an air

tight room. Provide a minimum of 2 - 900 mm (3 foot) wide flapped doorways. One doorway shall be the entry from outside the PDF and the second doorway shall be to the shower room of the PDF. The floor of the clean room shall be maintained in a clean, dry condition. Shower overflow shall not be allowed into the clean room. An adequate supply of disposable towels shall be provided. Provide storage lockers per person. A portable fire extinguisher, Type ABC, shall be provided in accordance with OSHA and NFPA Standard 10. All persons entering the regulated area shall remove all street clothing in the clean room and dress in disposable protective clothing and respiratory protection. Any person entering the clean room does so either from the outside with street clothing on or is coming from the shower room completely naked and thoroughly washed. Females required to enter the regulated area shall be ensured of their privacy throughout the entry/exit process by posting guards at both entry points to the PDF so no male can enter or exit the PDF during her stay in the PDF.

2. Shower Room: The Competent Person shall assure that the shower room is a completely water tight compartment to be used for the movement of all personnel from the clean room to the equipment room and for the showering of all personnel going from the regulated area to the clean room. Each shower shall be constructed so water runs down the walls of the shower and into a drip pan. Install a freely draining smooth floor on top of the shower pan. The shower room shall be separated from the rest of the building and from the clean room and equipment room using air tight walls made from at least 3 layers of 6 mil fire retardant poly. The shower shall be equipped with a shower head and controls, hot and cold water, drainage, soap dish and continuous supply of soap, and shall be maintained in a sanitary condition throughout its use. The controls shall be arranged so an individual can shower without assistance. Provide a flexible hose shower head, hose bibs and all other items shown on Shower Schematic. Waste water will be pumped to a drain after being filtered through a minimum of a 100 micron sock in the shower drain; a 20 micron filter; and a final 5 micron filter. Filters will be changed a minimum of daily or more often as needed. Filter changes must be done in the shower to prevent loss of contaminated water. Hose down all shower surfaces after each shift and clean any debris from the shower pan. Residue is to be disposed of as asbestos waste.
3. Equipment Room: The Competent Person shall provide an equipment room which shall be an air tight compartment for the storage of work equipment, reusable footwear and for use as a change station for personnel exiting the regulated area. The equipment room shall be separated from the regulated area by a minimum 3 foot wide door made of 2 layers of 6 mil fire retardant poly. The equipment room shall be separated from the regulated area, the shower room and the rest of the building by air tight walls and ceiling constructed of a minimum of 3 layers of 6 mil fire retardant poly. Damp wipe all surfaces of the equipment room after each shift change. Provide an additional loose layer of 6 mil fire retardant poly per shift change and remove this layer after each shift. Provide a temporary electrical sub-panel equipped with GFCI in this room to accommodate any equipment required in the regulated area.
4. The PDF shall consist of the following: Clean room at the entrance followed by a shower room followed by an equipment room leading to

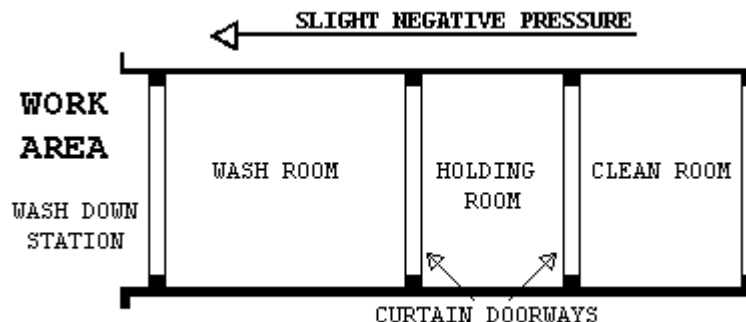
the regulated area. Each doorway in the PDF is minimum of 2 layers of 6 mil fire retardant poly.



1.9.5 WASTE/EQUIPMENT DECONTAMINATION FACILITY (W/EDF)

The Competent Person shall provide a W/EDF consisting of a wash room, holding room, and clean room for removal of all waste, equipment and contaminated material from the regulated area. Personnel shall not enter or exit the W/EDF except in the event of an emergency. Clean debris and residue in the W/EDF daily. All surfaces in the W/EDF shall be wiped/hosed down after each shift and all debris shall be cleaned from the shower pan. The W/EDF shall consist of the following:

1. Wash Down Station: Provide an enclosed shower unit in the regulated area just outside the Wash Room as an equipment, bag and container cleaning station.
2. Wash Room: Provide a wash room for cleaning of bagged or containerized asbestos containing waste materials passed from the regulated area. Construct the wash room using 50 x 100 mm (2" x 4") wood framing and 3 layers of 6 mil fire retardant poly. Locate the wash room so that packaged materials, after being wiped clean, can be passed to the Holding Room. Doorways in the wash room shall be constructed of 2 layers of 6 mil fire retardant poly.
3. Holding Room: Provide a holding room as a drop location for bagged materials passed from the wash room. Construct the holding room using 50 x 100 mm (2" x 4") wood framing and 3 layers of 6 mil fire retardant poly. The holding room shall be located so that bagged material cannot be passed from the wash room to the clean room unless it goes through the holding room. Doorways in the holding room shall be constructed of 2 layers of 6 mil fire retardant poly.
4. Clean Room: Provide a clean room to isolate the holding room from the building exterior. Construct the clean room using 2 x 4 wood framing and 2 layers of 6 mil fire retardant poly. The clean room shall be located so as to provide access to the holding room from the building exterior. Doorways to the clean room shall be constructed of two layers of 6 mil fire retardant poly.
5. The W/EDF shall be provided as follows: Wash Room leading to a Holding Room followed by a Clean Room leading to outside the regulated area. See diagram.



1.9.6 WASTE/EQUIPMENT DECONTAMINATION PROCEDURES

At washdown station in the regulated area, thoroughly wet clean contaminated equipment and/or sealed polyethylene bags and pass into Wash Room after visual inspection. When passing anything into the Wash Room, close all doorways of the W/EDF, other than the doorway between the washdown station and the Wash Room. Keep all outside personnel clear of the W/EDF. Once inside the Wash Room, wet clean the equipment and/or bags. After cleaning and inspection, pass items into the Holding Room. Close all doorways except the doorway between the Holding Room and the Clean Room. Workers from the Clean Room/Exterior shall enter the Holding Room and remove the decontaminated/cleaned equipment/bags for removal and disposal. These personnel will not be required to wear PPE. At no time shall personnel from the clean side be allowed to enter the Wash Room.

PART 2 - PRODUCTS, MATERIALS AND EQUIPMENT

2.1 MATERIALS AND EQUIPMENT

2.1.1 GENERAL REQUIREMENTS (ALL ABATEMENT PROJECTS)

Prior to the start of work, the Contractor shall provide and maintain a sufficient quantity of materials and equipment to assure continuous and efficient work throughout the duration of the project. Work shall not start unless the following items have been delivered to the site and the CPIH has submitted verification to the VA's representative to this effect:

- A. All materials shall be delivered in their original package, container or bundle bearing the name of the manufacturer and the brand name (where applicable).
- B. Store all materials subject to damage off the ground, away from wet or damp surfaces and under cover sufficient enough to prevent damage or contamination. Flammable materials cannot be stored inside buildings. Replacement materials shall be stored outside of the regulated/work area until abatement is completed.
- C. The Contractor shall not block or hinder use of buildings by patients, staff, and visitors to the VA in partially occupied buildings by placing materials/equipment in any unauthorized place.

- D. The Competent Person shall inspect for damaged, deteriorating or previously used materials. Such materials shall not be used and shall be removed from the worksite and disposed of properly.
- E. Poly sheeting put under the glovebag regulated area shall be a minimum of 6 mils in thickness.
- F. If required, the method of attaching polyethylene sheeting shall be agreed upon in advance by the Contractor and the VA and selected to minimize damage to equipment and surfaces.
- G. Polyethylene sheeting utilized for personnel decontamination facility shall be opaque white or black in color, 6 mil fire retardant poly.
- H. Installation and plumbing hardware, showers, hoses, drain pans, sump pumps and waste water filtration system shall be provided by the Contractor.
- I. An adequate number of HEPA vacuums, scrapers, sprayers, nylon brushes, brooms, disposable mops, rags, sponges, staple guns, shovels, ladders and scaffolding of suitable height and length as well as meeting OSHA requirements shall be provided. Fall protection devices, water hose to reach all areas in the regulated area, airless spray equipment, and any other tools, materials or equipment required to conduct the abatement project shall also be provided. All electrically operated hand tools, equipment, electric cords shall be equipped with GFCI protection.
- J. Special protection for objects in the regulated area shall be detailed (e.g., plywood over carpeting or hardwood floors to prevent damage from scaffolds, water, and falling material).
- K. Disposal bags - 2 layers of 6 mil, for asbestos waste shall be pre-printed with labels, markings and address as required by OSHA, EPA and DOT regulations.
- L. The VA shall be provided a copy of the MSDS as required for all hazardous chemicals under OSHA 29 CFR 1910.1200 - Hazard Communication. Chlorinated compounds shall not be used with any spray adhesive or other product. Appropriate encapsulant(s) shall be provided.
- M. OSHA DANGER demarcation signs, as many and as required by OSHA 29 CFR 1926.1101(k)(7) shall be provided and placed by the Competent Person. All other posters and notices required by Federal and State regulations shall be posted in the Clean Room.
- N. Adequate and appropriate PPE for the project and number of personnel/shifts shall be provided. All personal protective equipment issued must be based on a hazard assessment conducted under 29 CFR 1910.132(d).

2.2 CONTAINMENT BARRIERS AND COVERINGS IN THE REGULATED AREA

2.2.1 GENERAL

Using critical barriers, seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent spaces. All horizontal surfaces in the regulated area must be covered with 2 layers of 6 mil fire retardant poly to prevent contamination and to facilitate clean-up. Should adjacent areas become contaminated, immediately stop

work and clean up the contamination at no additional cost to the Government. Provide firestopping and identify all fire barrier penetrations due to abatement work as specified in Section 2.2.8; FIRESTOPPING.

2.2.2 PREPARATION PRIOR TO SEALING THE REGULATED AREA

- A. Place all tools, scaffolding, materials and equipment needed for working in the regulated area prior to erecting any plastic sheeting. Remove all uncontaminated removable furniture, equipment and/or supplies from the regulated area before commencing work, or completely cover with 2 layers of 6-mil fire retardant poly sheeting and secure with duct tape. Lock out and tag out any HVAC systems in the regulated area.

2.2.3 CONTROLLING ACCESS TO THE REGULATED AREA

- A. Access to the regulated area is allowed only through the personnel decontamination facility (PDF), if required. All other means of access shall be eliminated and OSHA Danger demarcation signs posted as required by OSHA. If the regulated area is adjacent to or within view of an occupied area, provide a visual barrier of 6 mil opaque fire retardant poly sheeting to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid.

2.2.4 CRITICAL BARRIERS

- A. Completely separate any openings into the regulated area from adjacent areas using fire retardant poly at least 6 mils thick and duct tape. Individually seal with 2 layers of 6 mil poly and duct tape all HVAC openings into the regulated area. Individually seal all lighting fixtures, clocks, doors, windows, convectors, speakers, or any other objects in the regulated area. Heat must be shut off any objects covered with poly.

2.2.5 SECONDARY BARRIERS

- A. A loose layer of 6 mil fire retardant poly shall be used as a drop cloth to protect the floor/horizontal surfaces from debris generated during the glovebag abatement. This layer shall be replaced as needed during the work.

2.2.6 EXTENSION OF THE REGULATED AREA

- A. If the enclosure of the regulated area is breached in any way that could allow contamination to occur, the affected area shall be included in the regulated area and constructed as per this section. If the affected area cannot be added to the regulated area, decontamination measures must be started immediately and continue until air monitoring indicates background levels are met.

2.2.7 FIRESTOPPING

- A. Through penetrations caused by cables, cable trays, pipes, sleeves must be firestopped with a fire-rated firestop system providing an air tight seal.
- B. Firestop materials that are not equal to the wall or ceiling penetrated shall be brought to the attention of the VA Representative. The Contractor shall list all areas of penetration, the type of sealant used, and whether or not the

location is fire rated. Any discovery of penetrations during abatement shall be brought to the attention of the VA Representative immediately. All walls, floors and ceilings are considered fire rated unless otherwise determined by the VA Representative or Fire Marshall.

- C. Any visible openings whether or not caused by a penetration shall be reported by the Contractor to the VA Representative for a sealant system determination. Firestops shall meet ASTM E814 and UL 1479 requirements for the opening size, penetrant, and fire rating needed.

2.3 MONITORING, INSPECTION AND TESTING

2.3.1 GENERAL

- A. Perform throughout abatement work monitoring, inspection and testing inside and around the regulated area in accordance with the OSHA requirements and these specifications. The CPIH shall periodically inspect and oversee the performance of the Contractor IH Technician. The IH Technician shall continuously inspect and monitor conditions inside the regulated area to ensure compliance with these specifications. In addition, the CPIH shall personally manage air sample collection, analysis, and evaluation for personnel, regulated area, and adjacent area samples to satisfy OSHA requirements. Additional inspection and testing requirements are also indicated in other parts of this specification.
- B. The VA will employ an independent industrial hygienist (VPIH/CIH) consultant and/or use its own IH to perform various services on behalf of the VA. The VPIH/CIH will perform the necessary monitoring, inspection, testing, and other support services to ensure that VA patients, employees, and visitors will not be adversely affected by the abatement work, and that the abatement work proceeds in accordance with these specifications, that the abated areas or abated buildings have been successfully decontaminated. The work of the VPIH/CIH consultant in no way relieves the Contractor from their responsibility to perform the work in accordance with contract/specification requirements, to perform continuous inspection, monitoring and testing for the safety of their employees, and to perform other such services as specified. The cost of the VPIH/CIH and their services will be borne by the VA except for any repeat of final inspection and testing that may be required due to unsatisfactory initial results. Any repeated final inspections and/or testing, if required, will be paid for by the Contractor.
- C. If fibers counted by the VPIH/CIH during abatement work, either inside or outside the regulated area, utilizing the NIOSH 7400 air monitoring method, exceed the specified respective limits, the Contractor shall stop work. The Contractor may request confirmation of the results by analysis of the samples by TEM. Request must be in writing and submitted to the VA's representative. Cost for the confirmation of results will be borne by the Contractor for both the collection and analysis of samples and for the time delay that may/does result for this confirmation. Confirmation sampling and analysis will be the responsibility of the CPIH with review and approval of the VPIH/CIH. An agreement between the CPIH and the VPIH/CIH shall be reached on the exact details of the confirmation effort, in writing, including such things as the number of samples, location, collection, quality control on-site, analytical laboratory, interpretation of results

and any follow-up actions. This written agreement shall be co-signed by the IH's and delivered to the VA's representative.

2.3.2 SCOPE OF SERVICES OF THE VPIH/CIH CONSULTANT

- A. The purpose of the work of the VPIH/CIH is to: Assure quality; resolve problems; and prevent the spread of contamination beyond the regulated area. In addition, their work includes performing the final inspection and testing to determine whether the regulated area or building has been adequately decontaminated. All air monitoring is to be done utilizing PCM/TEM.
- B. All data, inspection results and testing results generated by the VPIH/CIH will be available to the Contractor for information and consideration. The Contractor shall cooperate with and support the VPIH/CIH for efficient and smooth performance of their work.
- C. The monitoring and inspection results of the VPIH/CIH will be used by the VA to issue any Stop Removal orders to the Contractor during abatement work and to accept or reject a regulated area or building as decontaminated.

2.3.3 MONITORING, INSPECTION AND TESTING BY ABATEMENT CONTRACTOR CPIH

The CPIH is responsible for managing all monitoring, inspections, and testing required by these specifications, as well as any and all regulatory requirements adopted by these specifications. The CPIH is responsible for the continuous monitoring of all subsystems and procedures which could affect the health and safety of the Contractor's personnel. Safety and health conditions and the provision of those conditions inside the regulated area for all persons entering the regulated area is the exclusive responsibility of the Contractor /Competent Person. The person performing the personnel and area air monitoring inside the regulated area shall be an IH Technician, who shall be trained and shall have specialized field experience in air sampling and analysis. The IH Technician shall have a NIOSH 582 Course or equivalent and show proof. The IH Technician shall participate in the AIHA Asbestos Analysis Registry or participate in the Proficiency Analytic Testing program of AIHA for fiber counting quality control assurance. The IH Technician shall also be an accredited EPA/State Contractor/Supervisor and Building Inspector. The IH Technician shall have participated in five abatement projects collecting personal and area samples as well as responsibility for documentation. The analytic laboratory used by the Contractor to analyze the samples shall be AIHA accredited for asbestos PAT. A daily log documenting all OSHA requirements for air monitoring for asbestos in 29 CFR 1926.1101(f), (g) and Appendix A. This log shall be made available to the VA representative and the VPIH/CIH. The log will contain, at a minimum, information on personnel or area sampled, other persons represented by the sample, the date of sample collection, start and stop times for sampling, sample volume, flow rate, and fibers/cc. The CPIH shall collect and analyze samples for each representative job being done in the regulated area, i.e., removal, wetting, clean-up, and load-out. No fewer than two personal samples per shift shall be collected and one area sample per 1,000 square feet of regulated area where abatement is taking place and one sample per shift in the clean room area shall be collected. In addition to the continuous monitoring required, the CPIH will perform inspection and testing at the final stages of abatement for each regulated area as specified in the CPIH responsibilities.

2.4 STANDARD OPERATING PROCEDURES

The Contractor shall have established Standard Operating Procedures (SOP's) in printed form and loose leaf folder consisting of simplified text, diagrams, sketches, and pictures that establish and explain clearly the ways and procedures to be followed during all phases of the work by the Contractor's personnel. The SOP's must be modified as needed to address specific requirements of the project. The SOP's shall be submitted for review and approval prior to the start of any abatement work. The minimum topics and areas to be covered by the SOP's are:

- A. Minimum Personnel Qualifications
- B. Contingency Plans and Arrangements
- C. Security and Safety Procedures
- D. Respiratory Protection/Personal Protective Equipment Program and Training
- E. Medical Surveillance Program and Recordkeeping
- F. Regulated Area Requirements for Glovebag Abatement
- G. Decontamination Facilities and Entry/Exit Procedures (PDF and W/EDF)
- H. Monitoring, Inspections, and Testing
- I. Removal Procedures For Piping ACM Using the Glovebag Method
- J. Disposal of ACM waste
- K. Regulated Area Decontamination/Clean-up
- L. Regulated Area Visual and Air Clearance
- M. Project Completion/Closeout

2.5 SUBMITTALS

2.5.1 PRE-CONSTRUCTION MEETING SUBMITTALS

Submit to the VA a minimum of 14 days prior to the pre-start meeting the following for review and approval. Meeting this requirement is a prerequisite for the pre-start meeting for this project.

- A. Submit a detailed work schedule for the entire project reflecting contract documents and the phasing/schedule requirements from the CPM chart.
- B. Submit a staff organization chart showing all personnel who will be working on the project and their capacity/function. Provide their qualifications, training, accreditations, and licenses, as appropriate. Provide a copy of the "Certificate of Worker's Acknowledgment" and the "Affidavit of Medical Surveillance and Respiratory Protection" for each person.
- C. Submit Standard Operating Procedures developed specifically for this project, incorporating the requirements of the specifications, prepared, signed and dated by the CPIH.

- D. Submit the specifics of the materials and equipment to be used for this project with brand names, model numbers, performance characteristics, pictures/diagrams, and number available for the following:
 - 1. HEPA vacuums, air monitoring pumps, calibration devices, and emergency power generating system.
 - 2. Waste water filtration system, shower system, critical/floor barriers.
 - 3. Encapsulants, surfactants, hand held sprayers, airless sprayers, glovebags, fire extinguishers.
 - 4. Personal protective equipment.
 - 5. Fire safety equipment to be used in the regulated area.
- E. Submit the name, location, and phone number of the approved landfill; proof/verification the landfill is approved for ACM disposal; the landfill's requirements for ACM waste; the type of vehicle to be used for transportation; and name, address, and phone number of subcontractor, if used. Proof of asbestos training for transportation personnel shall be provided.
- F. Submit required notifications and arrangements made with regulatory agencies having regulatory jurisdiction and the specific contingency/emergency arrangements made with local health, fire, ambulance, hospital authorities and any other notifications/arrangements.
- G. Submit the name, location and verification of the laboratory and/or personnel to be used for analysis of air and/or bulk samples. Air monitoring must be done in accordance with OSHA 29 CFR 1926.1101(f) and Appendix A.
- H. Submit qualifications verification: Submit the following evidence of qualifications. Make sure that all references are current and verifiable by providing current phone numbers and documentation.
 - 1. Asbestos Abatement Company: Project experience within the past 3 years; listing projects first most similar to this project:
Project Name; Type of Abatement; Duration; Cost; Reference Name/Phone Number; Final Clearance; Completion Date
 - 2. List of project(s) halted by owner, A/E, IH, regulatory agency in the last 3 years:
Project Name; Reason; Date; Reference Name/Number; Resolution
 - 3. List asbestos regulatory citations, penalties, damages paid and legal actions taken against the company in the last 3 years. Provide copies and all information needed for verification.
- I. Submit information on personnel: Provide a resume; address each item completely; provide references; phone numbers; copies of certificates, accreditations, and licenses. Submit an affidavit signed by the CPIH stating that all personnel submitted below have medical records in accordance with OSHA 29 CFR 1926.1101(m) and 29 CFR 1910.20 and that the company has implemented a medical surveillance program and maintains recordkeeping in accordance

with the above regulations. Submit the phone number and doctor/clinic/hospital used for medical evaluations.

1. CPIH: Name; years of abatement experience; list of projects similar to this one; certificates, licenses, accreditations for proof of AHERA/OSHA specialized asbestos training; professional affiliations; number of workers trained; samples of training materials; samples of SOP's developed; medical opinion; current respirator fit test.
 2. Competent Person(s)/Supervisor(s): Number; names; social security numbers; years of abatement experience as Competent Person /Supervisor; list of similar projects as Competent Person/Supervisor; as a worker; certificates, licenses, accreditations; proof of AHERA/OSHA specialized asbestos training; maximum number of personnel supervised on a project; medical opinion; current respirator fit test.
 3. Workers: Numbers; names; social security numbers; years of abatement experience; certificates, licenses, accreditations; training courses in asbestos abatement and respiratory protection; medical opinion; current respirator fit test.
- J. Submit copies of State license for asbestos abatement; copy of insurance policy, including exclusions with a letter from agent stating in plain english the coverage provided and the fact that asbestos abatement activities are covered by the policy; copy of SOP's incorporating the requirements of this specification; information on who provides your training, how often; who provides medical surveillance, how often; who does and how is air monitoring conducted; a list of references of independent laboratories/IH's familiar with your air monitoring and standard operating procedures; copies of monitoring results of the five referenced projects listed and analytical method(s) used.
- K. When rental equipment is to be used in regulated areas or used to transport asbestos waste, the contractor shall assure complete decontamination of the rental equipment before return to the rental agency.
1. Submit, before the start of work, the manufacturer's technical data and MSDS for encapsulants used on the project. Provide application instructions also.

2.5.2 SUBMITTALS DURING ABATEMENT

- A. The Competent Person shall maintain and submit a daily log at the regulated area documenting the dates and times of the following: purpose, attendees and summary of meetings; all personnel entering/exiting the regulated area; document and discuss the resolution of unusual events such as critical barrier breeching, equipment failures, emergencies, and any cause for stopping work; representative air monitoring and results/TWA's/EL's. Submit this daily log to VA's representative.
- B. The CPIH shall document and maintain the following during abatement and submit as appropriate to the VA's representative.
1. Inspection and approval of the regulated area preparation prior to start of work and daily during work.

2. Removal of any poly critical/floor barriers.
3. Visual inspection/testing by the CPIH prior to application of lockdown encapsulation.
4. Packaging and removal of ACM waste from regulated area.
5. Disposal of ACM waste materials; copies of Waste Shipment Records/landfill receipts to the VA's representative on a weekly basis.

2.5.3 SUBMITTALS AT COMPLETION OF ABATEMENT

The CPIH shall submit a project report consisting of the daily log book requirements and documentation of events during the abatement project including Waste Shipment Records signed by the landfill's agent. The report shall include a certificate of completion, signed and dated by the CPIH, in accordance with Attachment #1. The VA Representative will forward the abatement report to the Medical Center after completion of the project.

2.6 ENCAPSULANTS

2.6.1 TYPES OF ENCAPSULANTS

- A. The following four types of encapsulants must comply with performance requirements as stated in paragraph 2.6.2:
 1. Removal encapsulant - used as a wetting agent to remove ACM.
 2. Bridging encapsulant - provides a tough, durable coating on ACM.
 3. Penetrating encapsulant - penetrates/encapsulates ACM at least 13 mm (1/2").
 4. Lockdown encapsulant - seals microscopic fibers on surfaces after ACM removal.

2.6.2 PERFORMANCE REQUIREMENTS

Encapsulants shall meet the latest requirements of EPA; shall not contain toxic or hazardous substances; or solvents; and shall comply with the following performance requirements:

- A. General Requirements for all Encapsulants:
 1. ASTM E84: Flame spread of 25; smoke emission of 50.
 2. University of Pittsburgh Protocol: Combustion Toxicity; zero mortality.
 3. ASTM C732: Accelerated Aging Test; Life Expectancy - 20 years.
 4. ASTM E96: Permeability - minimum of 0.4 perms.
- B. Bridging/Penetrating Encapsulants:
 1. ASTM E736: Cohesion/Adhesion Test - 24 kPa (50 lbs/ft²).

2. ASTM E119: Fire Resistance - 3 hours (Classified by UL for use on fibrous/cementitious fireproofing).
3. ASTM D2794: Gardner Impact Test; Impact Resistance - minimum 11.5 kg-mm (43 in/lb).
4. ASTM D522: Mandrel Bend Test; Flexibility - no rupture or cracking.

C. Lockdown Encapsulants:

1. ASTM E119: Fire resistance - 3 hours (tested with fireproofing over encapsulant applied directly to steel member).
2. ASTM E736: Bond Strength - 48 kPa (100 lbs/ft²) (test compatibility with cementitious and fibrous fireproofing).
3. In certain situations, encapsulants may have to be applied to hot pipes/equipment. The encapsulant must be able to withstand high temperatures without cracking or off-gassing any noxious vapors during application.

2.7 CERTIFICATES OF COMPLIANCE

The Contractor shall submit to the VA representative certification from the manufacturer indicating compliance with performance requirements for encapsulants when applied according to manufacturer recommendations.

2.8 RECYCLABLE PROTECTIVE CLOTHING

If recyclable clothing is provided, all requirements of EPA, DOT and OSHA shall be met.

PART 3 - EXECUTION

3.1 PRE-ABATEMENT ACTIVITIES

3.1.1 PRE-ABATEMENT MEETING

The VA representative, upon receipt, review, and substantial approval of all pre-abatement submittals and verification by the CPIH that all materials and equipment required for the project are on the site, will arrange for a pre-abatement meeting between the Contractor, the CPIH, Competent Person(s), the VA representative(s), and the VPIH/CIH. The purpose of the meeting is to discuss any aspect of the submittals needing clarification or amplification and to discuss any aspect of the project execution and the sequence of the operation. The Contractor shall be prepared to provide any supplemental information/documentation to the VA's representative regarding any submittals, documentation, materials or equipment. Upon satisfactory resolution of any outstanding issues, the VA's representative will issue a written order to proceed to the Contractor. No abatement work of any kind described in the following provisions shall be initiated prior to the VA written order to proceed.

3.1.2 PRE-ABATEMENT INSPECTIONS AND PREPARATIONS

Before any work begins on the construction of the regulated area, the Contractor will:

- A. Conduct a space-by-space inspection with an authorized VA representative and prepare a written inventory of all existing

damage in those spaces where asbestos abatement will occur. Still or video photography may be used to supplement the written damage inventory. Document will be signed and certified as accurate by both parties.

- B. The VA Representative, the Contractor, and the VPIH/CIH must be aware of 10/95 A/E Quality Alert indicating the failure to identify asbestos as applicable to glovebag abatement in the areas listed. Make sure these areas are looked at/reviewed on the project: Lay-in ceilings concealing ACM; ACM behind walls/windows from previous renovations; inside chases/walls; transite piping/ductwork/sheets; behind radiators; below window sills; water/sewer lines; electrical conduit coverings; steam line trench coverings.
- C. Ensure that all furniture, machinery, equipment, curtains, drapes, blinds, and other movable objects which the Contractor is required to remove from the regulated area have been cleaned and removed or properly protected from contamination.
- D. Shut down and seal with a minimum of 2 layers of 6 mil fire retardant poly all HVAC systems serving the regulated area. The regulated area critical barriers shall be completely isolated from any other air in the building. The VA's representative will monitor the isolation provision.
- E. Shut down and lock out in accordance with 29 CFR 1910.147 all electrical circuits which pose a potential hazard. Electrical arrangements will be tailored to the particular regulated area and the systems involved. All electrical circuits affected will be turned off at the circuit box outside the regulated area, not just the wall switch. The goal is to eliminate the potential for electrical shock which is a major threat to life in the regulated area due to water use and possible energized circuits. Electrical lines used to power equipment in the regulated area shall conform to all electrical safety standards and shall be isolated by the use of a ground fault circuit interrupter (GFCI). All GFCI shall be tested prior to use. The VA's representative will monitor the electrical shutdown.
- F. If required, remove and dispose of carpeting from floors in the regulated area.
- G. Inspect existing firestopping in the regulated area. Correct as needed.

3.1.3 PRE-ABATEMENT CONSTRUCTION AND OPERATIONS

- A. Perform all preparatory work for the first regulated area in accordance with the approved work schedule and with this specification.
- B. Upon completion of all preparatory work, the CPIH will inspect the work and systems and will notify the VA's representative when the work is completed in accordance with this specification. The VA's representative may inspect the regulated area and the systems with the VPIH/CIH and may require that upon satisfactory inspection, the Contractor's employees perform all major aspects of the approved SOP's, especially worker protection, respiratory systems, contingency plans, decontamination procedures, and monitoring to demonstrate satisfactory operation.

- C. The CPIH shall document the pre-abatement activities described above and deliver a copy to the VA's representative.
- D. Upon satisfactory inspection of the installation of and operation of systems the VA's representative will notify the Contractor in writing to proceed with the asbestos abatement work in accordance with this specification.

3.2 REGULATED AREA PREPARATIONS

3.2.1 OSHA DANGER SIGNS

Post OSHA DANGER signs meeting the specifications of OSHA 29 CFR 1926.1101 at any location and approaches to the regulated area where airborne concentrations of asbestos may exceed ambient background levels. Signs shall be posted at a distance sufficiently far enough away from the regulated area to permit any personnel to read the sign and take the necessary measures to avoid exposure. Additional signs will be posted following construction of the regulated area enclosure.

3.2.2 SHUT DOWN - LOCK OUT ELECTRICAL

Shut down and lock out electric power to the regulated area. Provide temporary power and lighting. Ensure safe installation including GFCI of temporary power sources and equipment by compliance with all applicable electrical code requirements and OSHA requirements for temporary electrical systems. Electricity shall be provided by the VA.

3.2.3 SHUT DOWN - LOCK OUT HVAC

Shut down and lock out heating, cooling, and air conditioning system (HVAC) components that are in, supply or pass through the regulated area.

Investigate the regulated area and agree on pre-abatement condition with the VA's representative. Seal all intake and exhaust vents in the regulated area with duct tape and 2 layers of 6-mil poly. Also, seal any seams in system components that pass through the regulated area. Remove all contaminated HVAC system filters and place in labeled 6-mil poly disposal bags for disposal as asbestos waste.

3.2.4 SANITARY FACILITIES

The Contractor shall provide sanitary facilities for abatement personnel and maintain them in a clean and sanitary condition throughout the abatement project.

3.2.5 WATER FOR ABATEMENT

The VA will provide water for abatement purposes. The Contractor shall connect to the existing VA system. The service to the shower(s) shall be supplied with backflow prevention.

3.2.6 PRE-CLEANING MOVABLE OBJECTS

Pre-clean all movable objects within the regulated area using a HEPA filtered vacuum and/or wet cleaning methods as appropriate. After cleaning, these objects shall be removed from the regulated area and carefully stored in an uncontaminated location.

3.2.7 PRE-CLEANING FIXED OBJECTS

Pre-clean all fixed objects in the regulated area using HEPA filtered vacuums and/or wet cleaning techniques as appropriate. Careful attention must be paid to machinery behind grills or gratings where access may be difficult but contamination may be significant. Also, pay particular attention to wall, floor and ceiling penetration behind fixed items. After precleaning, enclose fixed objects with 2 layers of 6-mil poly and seal securely in place with duct tape. Objects (e.g., permanent fixtures, shelves, electronic equipment, laboratory tables, sprinklers, alarm systems, closed circuit TV equipment and computer cables) which must remain in the regulated area and that require special ventilation or enclosure requirements should be designated here along with specified means of protection. Contact the manufacturer for special protection requirements.

3.2.8 PRE-CLEANING SURFACES IN THE REGULATED AREA

Pre-clean all surfaces in the regulated area using HEPA filtered vacuums and/or wet cleaning methods as appropriate. Do not use any methods that would raise dust such as dry sweeping or vacuuming with equipment not equipped with HEPA filters. Do not disturb asbestos-containing materials during this pre-cleaning phase.

3.3 CONTAINMENT BARRIERS AND COVERINGS FOR THE REGULATED AREA

3.3.1 GENERAL

Seal off any openings at the perimeter of the regulated area with critical barriers to completely isolate the regulated area and to contain all airborne asbestos contamination created by the abatement activities. Should the adjacent area past the regulated area become contaminated due to improper work activities, the Contractor shall suspend work inside the regulated area, continue wetting, and clean the adjacent areas in accordance with procedures described in these specifications. Any and all costs associated with the adjacent area cleanup shall not be borne by the VA.

3.3.2 PREPARATION PRIOR TO SEALING OFF

Place all materials, equipment and supplies necessary to isolate the regulated area inside the regulated area. Remove all movable material/equipment as described above and secure all unmovable material/equipment as described above. Properly secured material/equipment shall be considered to be outside the regulated area.

3.3.3 CONTROLLING ACCESS TO THE REGULATED AREA

Access to the regulated area shall be permitted only through the PDF. All other means of access shall be closed off by proper sealing and DANGER signs posted on the clean side of the regulated area where it is adjacent to or within view of any occupiable area. An opaque visual barrier of 6 mil poly shall be provided so that the abatement work is not visible to any building occupants. If the area adjacent to the regulated area is accessible to the public, construct a solid barrier on the public side of the sheeting for protection and isolation of the project. The barrier shall be constructed with nominal 2" x 4" (50mm x 100mm) wood or metal studs 16" (400mm) on centers, securely anchored to prevent movement and covered with a minimum of 1/2" (12.5mm) plywood. Provide an appropriate number of OSHA DANGER signs for each visual and physical barrier. Any alternative method must be given a written approval by the VA's representative.

3.3.4 CRITICAL BARRIERS

The regulated area must be completely separated from the adjacent areas, and the outside by at least 2 layers of 6 mil fire retardant poly and duct tape/spray adhesive. Individually seal all supply and exhaust ventilation openings, lighting fixtures, clocks, doorways, windows, convectors, speakers, and other openings into the regulated area with 2 layers of 6 mil fire retardant poly, and taped securely in place with duct tape/spray adhesive. Critical barriers must remain in place until all work and clearances have been completed. Light fixtures shall not be operational during abatement. Auxiliary lighting shall be provided. If needed, provide plywood squares 6" x 6" x 3/8" (150mm x 150mm x 18mm) held in place with one 6d smooth masonry/galvanized nail driven through the center of the plywood square and duct tape on the poly so as to clamp the poly to the wall/surface. Locate plywood squares at each end, corner, and 4' (1200mm) maximum on centers.

3.3.5 EXTENSION OF THE REGULATED AREA

If the regulated area barrier is breached in any manner that could allow the passage of asbestos fibers or debris, the Competent Person shall immediately stop work, continue wetting, and proceed to extend the regulated area to enclose the affected area as per procedures described in this specification. If the affected area cannot be enclosed, decontamination measures and cleanup shall start immediately. All personnel shall be isolated from the affected area until decontamination/cleanup is completed as verified by visual inspection and air monitoring. Air monitoring at completion must indicate background levels.

3.3.6 FLOOR BARRIERS:

All floors within 10' of glovebag work shall be covered with 2 layers of 6 mil fire retardant poly.

3.4 REMOVAL OF PIPING ACM

3.4.1 WETTING MATERIALS

- A. Use amended water for the wetting of ACM prior to removal. The Competent Person shall assure the wetting of ACM meets the definition of "adequately wet" in the EPA NESHAP's regulation and OSHA's "wet methods" for the duration of the project. A removal encapsulant may be used instead of amended water with written approval of the VA's representative.
- B. Amended Water: Provide water to which a surfactant has been added shall be used to wet the ACM and reduce the potential for fiber release during disturbance of ACM. The mixture must be equal to or greater than the wetting provided by water amended by a surfactant consisting one ounce of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with 5 gallons (19L) of water.
- C. Removal Encapsulant: Provide a penetrating encapsulant designed specifically for the removal of ACM. The material must, when used, result in adequate wetting of the ACM and retard fiber release during disturbance equal to or greater than the amended water described above in B.

3.4.2 SECONDARY BARRIER AND WALKWAYS

- A. Install as a drop cloth a 6 mil poly sheet at the beginning of each work shift where removal is to be done during that shift. Completely floors within 10 feet (3M) of the area where work is to be done. Secure the secondary barrier with duct tape to prevent debris from getting behind it. Remove the secondary barrier at the end of the shift or as work in the area is completed. Keep residue on the secondary barrier wetted. When removing, fold inward to prevent spillage and place in a disposal bag.
- B. Install walkways using 6 mil poly between the regulated area and the decontamination facilities (PDF and W/EDF) to protect the floor from contamination and damage. Install the walkways at the beginning of each shift and remove at the end of each shift.

3.4.3 WET REMOVAL OF ACM

- A. Using acceptable glovebag procedures, adequately and thoroughly wet the ACM to be removed prior to removal to reduce/prevent fiber release to the air. Adequate time must be allowed for the amended water to saturate the ACM. Abatement personnel must not disturb dry ACM. Use a fine spray of amended water or removal encapsulant. Saturate the material sufficiently to wet to the substrate without causing excessive dripping. The material must be sprayed repeatedly/continuously during the removal process in order to maintain adequately wet conditions. Removal encapsulants must be applied in accordance with the manufacturer's written instructions. Perforate or carefully separate, using wet methods, an outer covering that is painted or jacketed in order to allow penetration and wetting of the material. Where necessary, carefully remove covering while wetting to minimize fiber release. In no event shall dry removal occur except in the case of electrical hazards or a greater safety issue is possible!

3.5 GLOVEBAG REMOVAL PROCEDURES

3.5.1 GENERAL

All applicable OSHA requirements and glovebag manufacturer's recommendations shall be met during glove bagging operations.

- 1. Mix the surfactant with water in the garden sprayer, following the manufacturer's directions.
- 2. Have each employee put on a HEPA filtered respirator approved for asbestos and check the fit using the positive/negative fit check.
- 3. Have each employee put on a disposable full-body suit. Remember, the hood goes over the respirator straps.
- 4. Check closely the integrity of the glove bag to be used. Check all seams, gloves, sleeves, and glove openings. OSHA requires the bottom of the bag to be seamless.
- 5. Check the pipe where the work will be performed. If it is damaged (broken lagging, hanging, etc.), wrap the entire length of the pipe in poly sheeting and "candy stripe" it with duct tape.
- 6. Attach glovebag with required tools per manufacturer's instructions.

7. Using the smoke tube and aspirator bulb, test 10% of glovebags by placing the tube into the water porthole (two-inch opening to glove bag), and fill the bag with smoke and squeeze it. If leaks are found, they should be taped closed using duct tape and the bag should be retested with smoke.
8. Insert the wand from the water sprayer through the water porthole.
9. Insert the hose end from a HEPA vacuum into the upper portion of the glove bag.
10. Wet and remove the pipe insulation.
11. If the section of pipe is covered with an aluminum jacket, remove it first using the wire cutters to cut any bands and the tin snips to remove the aluminum. It is important to fold the sharp edges in to prevent cutting the bag when placing it in the bottom.
12. When the work is complete, spray the upper portion of the bag and clean-push all residue into the bottom of the bag with the other waste material. Be very thorough. Use adequate water.
13. Put all tools, after washing them off in the bag, in one of the sleeves of glove bag and turn it inside out, drawing it outside of the bag. Twist the sleeve tightly several times to seal it and tape it several tight turns with duct tape. Cut through the middle of the duct tape and remove the sleeve. Put the sleeve in the next glove bag or put it in a bucket of water to decontaminate the tools after cutting the sleeve open.
14. Turn on the HEPA vacuum and collapse the bag completely. Remove the vacuum nozzle, seal the hole with duct tape, twist the bag tightly several times in the middle, and tape it to keep the material in the bottom during removal of the glove bag from the pipe.
15. Slip a disposal bag over the glove bag (still attached to the pipe). Remove the tape securing the ends, and slit open the top of the glove bag and carefully fold it down into the disposal bag. Double bag and gooseneck waste materials.

3.6 LOCKDOWN ENCAPSULATION

3.6.1 GENERAL

Lockdown encapsulation is an integral part of the ACM removal. At the conclusion of ACM removal and before removal of the primary barriers, all piping surfaces shall be encapsulated with a bridging encapsulant.

3.6.2 SEALING EXPOSED EDGES

Seal edges of ACM exposed by removal work with two coats of encapsulant. Prior to sealing, permit the exposed edges to dry completely to permit penetration of the encapsulant.

3.7 DISPOSAL OF ACM WASTE MATERIALS

3.7.1 GENERAL

Dispose of waste ACM and debris which is packaged in accordance with these specifications, OSHA, EPA and DOT. The landfill requirements for packaging must also be met. Disposal shall be done at the approved

landfill. Disposal of non-friable ACM shall be done in accordance with applicable regulations.

3.7.2 PROCEDURES

- A. Asbestos waste shall be packaged and moved through the W/EDF into a covered transport container in accordance with procedures in this specification. Waste shall be double-bagged prior to disposal. Wetted waste can be very heavy. Bags shall not be overfilled. Bags shall be securely sealed to prevent accidental opening and/or leakage. The top shall be tightly twisted and goosenecked prior to tightly sealing with at least three wraps of duct tape. Ensure that unauthorized persons do not have access to the waste material once it is outside the regulated area. All transport containers must be covered at all times when not in use. NESHAP's signs must be on containers during loading and unloading. Material shall not be transported in open vehicles. If drums are used for packaging, the drums shall be labeled properly and shall not be re-used.
- B. Waste Load Out: Waste load out shall be done in accordance with the procedures in W/EDF Decontamination Procedures. Bags shall be decontaminated on exterior surfaces by wet cleaning and/or HEPA vacuuming before being placed in the second bag. C. Asbestos waste with sharp edged components, i.e., nails, screws, lath, strapping, tin sheeting, jacketing, metal mesh, etc., which might tear poly bags shall be wrapped securely in burlap before packaging and, if needed, use a poly lined fiber drum as the second container, prior to disposal.

3.8 PROJECT DECONTAMINATION

3.8.1 GENERAL

- A. The entire work related to project decontamination shall be performed under the close supervision and monitoring of the CPIH.
- B. If the asbestos abatement work is in an area which was contaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal and cleaning of the regulated area surfaces after the primary barrier removal.
- C. If the asbestos abatement work is in an area which was uncontaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal, thus preventing contamination of the building when the regulated area critical barriers are removed.

3.8.2 REGULATED AREA CLEARANCE

Air testing and other requirements which must be met before release of the Contractor and re-occupancy of the regulated area space are specified in Final Testing Procedures.

3.8.3 WORK DESCRIPTION

Decontamination includes the cleaning and clearance of the air in the regulated area and the decontamination and removal of the enclosures/facilities installed prior to the abatement work including primary/critical barriers, PDF and W/EDF facilities.

3.8.4 PRE-DECONTAMINATION CONDITIONS

- A. Before decontamination starts, all ACM waste from the regulated area shall be removed, all waste collected and removed, and the secondary barrier of poly removed and disposed of along with any gross debris generated by the work.
- B. At the start of decontamination, the following shall be in place:
 - 1. Critical barriers over all openings consisting of two layers of 6 mil poly which is the sole barrier between the regulated area and the rest of the building or outside.
 - 3. Decontamination facilities, if required for personnel and equipment in operating condition.

3.8.5 FIRST CLEANING

Carry out a first cleaning of all surfaces of the regulated area including items of remaining poly sheeting, tools, scaffolding, ladders/staging by wet methods and/or HEPA vacuuming. Do not use dry dusting/sweeping methods. Use each surface of a cleaning cloth one time only and then dispose of as contaminated waste. Continue this cleaning until there is no visible residue from abated surfaces or poly or other surfaces. If determined by the CPIH/VPIH/CIH additional cleaning(s) may be needed.

3.8.6 PRE-CLEARANCE INSPECTION AND TESTING

The CPIH and VPIH/CIH will perform a thorough and detailed visual inspection after the first cleaning to determine whether there is any visible residue in the regulated area. If the visual inspection is acceptable, the CPIH will perform pre-clearance sampling using aggressive clearance as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A(III)(B)(7)(d). If the sampling results show values below 0.01 f/cc, then the Contractor shall notify the VA's representative of the results with a brief report from the CPIH documenting the inspection and sampling results and a statement verifying that the regulated area is ready for lockdown encapsulation. The VA reserves the right to utilize their own VPIH/CIH to perform a pre-clearance inspection and testing for verification.

3.8.7 LOCKDOWN ENCAPSULATION OF ABATED SURFACES

With the express written permission of the VA's representative, perform lockdown encapsulation of all surfaces from which asbestos was abated in accordance with the procedures in this specification.

3.9 FINAL VISUAL INSPECTIONS AND AIR CLEARANCE TESTING

3.9.1 GENERAL

Notify the VA representative 24 hours in advance for the performance of the final visual inspection and testing. The final visual inspection and testing will be performed by the VPIH/CIH after the final cleaning.

3.9.2 FINAL VISUAL INSPECTION

Final visual inspection will include the entire regulated area, the PDF, all poly sheeting, seals over HVAC openings, doorways, windows, and any other openings. If any debris, residue, dust or any other suspect

material is detected, the final cleaning shall be repeated at no cost to the VA. Dust/material samples may be collected and analyzed at no cost to the VA at the discretion of the VPIH/CIH to confirm visual findings. When the regulated area is visually clean the final testing can be done.

3.9.3 FINAL AIR CLEARANCE TESTING

- A. After an acceptable final visual inspection by the VPIH/CIH and VA Representative, the VPIH/CIH will perform the final testing. Air samples will be collected and analyzed in accordance with procedures for PCM/TEM in this specification. If the release criteria are not met, the Contractor shall repeat the final cleaning and continue decontamination procedures. Additional inspection and testing will be done at the expense of the Contractor.
- B. If the results of the PCM/TEM are acceptable, remove the critical barriers. Any small quantities of residue material found upon removal of the poly shall be removed with a HEPA vacuum and localized isolation. If significant quantities are found as determined by the VPIH/CIH, then the entire area affected shall be cleaned as specified in the final cleaning.
- C. When release criteria are met, proceed to perform the abatement closeout and to issue the certificate of completion in accordance with these specifications.

3.9.4 FINAL AIR CLEARANCE PROCEDURES

- A. Contractor's Release Criteria: Work in a regulated area is complete when the regulated area is visually clean and airborne fiber levels have been reduced to or below 0.01 f/cc as measured with PCM/TEM methods.
- B. Air Monitoring and Final Clearance Sampling: To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to the specified level, the VPIH/CIH will secure samples and analyze them according to the following procedures:
 - 1. Fibers Counted: "Fibers" referred to in this section shall be either all fibers regardless of composition as counted in the NIOSH 7400 PCM method or asbestos fibers counted using the TEM method.
 - 2. Aggressive Sampling: All final air testing samples shall be collected using aggressive sampling techniques. Samples will be collected on 0.8µ MCE filters for PCM analysis and 0.45µ Polycarbonate filters for TEM analysis. Before pumps are started, initiate aggressive sampling as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A (III)(B)(7)(d). Air samples will be collected in areas subject to normal air circulation away from corners, obstructed locations, and locations near windows, doors, or vents. After air sampling pumps have been shut off, circulating fans shall be shut off.

3.9.5 CLEARANCE SAMPLING USING PCM

The NIOSH 7400 method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 5 PCM clearance samples will be collected.

3.9.6 CLEARANCE SAMPLING USING TEM

TEM clearance requires a minimum of 13 samples taken and analyzed, including five samples in the regulated area, five samples outside the regulated area and three field blanks using polycarbonate filters.

3.9.7 LABORATORY TESTING OF PCM SAMPLES

The services of an AIHA accredited laboratory will be employed by the VA to perform analysis of the air samples. Samples will be sent by the VPIH/CIH so that verbal/faxed reports can be received within 24 hours. A complete record, certified by the laboratory, of all air monitoring tests and results will be furnished to the VA's representative and the Contractor.

3.9.8 LABORATORY TESTING OF TEM SAMPLES

Samples shall be sent by the VPIH/CIH to an accredited laboratory for analysis by TEM. Verbal/faxed results from the laboratory shall be available within 24 hours after receipt of the samples. A complete record, certified by the laboratory, of all TEM results shall be furnished to the VA's representative and the Contractor.

3.10 ABATEMENT CLOSEOUT AND CERTIFICATE OF COMPLIANCE

3.10.1 COMPLETION OF ABATEMENT WORK

After thorough decontamination, complete asbestos abatement work upon meeting the regulated area clearance criteria and fulfilling the following:

- A. Remove all equipment, materials, and debris from the project area.
- B. Package and dispose of all asbestos waste as required.
- C. Repair or replace all interior finishes damaged during the abatement work.
- D. Fulfill other project closeout requirements as specified elsewhere in this specification.

3.10.2 CERTIFICATE OF COMPLETION BY CONTRACTOR

The CPIH shall complete and sign the "Certificate of Completion" in accordance with Attachment 1 at the completion of the abatement and decontamination of the regulated area.

3.10.3 WORK SHIFTS

All work shall be done during administrative hours (8:00 AM to 4:30 PM) Monday - Friday excluding Federal Holidays. Any change in the work schedule must be approved in writing by the VA Representative.

ATTACHMENT #1

CERTIFICATE OF COMPLETION

DATE:

PROJECT NAME:

VAMC/ADDRESS:

1. I certify that I have personally inspected, monitored and supervised the abatement work of

(specify regulated area or Building):
which took place from to.
2. That throughout the work all applicable requirements/regulations and the VA's specifications were met.
3. That any person who entered the regulated area was protected with the appropriate personal protective equipment and respirator and that they followed the proper entry and exit procedures and the proper operating procedures for the duration of the work.
4. That all employees of the Abatement Contractor engaged in this work were trained in respiratory protection, were experienced with abatement work, had proper medical surveillance documentation, were fit-tested for their respirator, and were not exposed at any time during the work to asbestos without the benefit of appropriate respiratory protection.
5. That I performed and supervised all inspection and testing specified and required by applicable regulations and VA specifications.
6. That the conditions inside the regulated area were always maintained in a safe and healthy condition and the maximum fiber count never exceeded 0.5 f/cc, except as described below.
7. That all glovebag work was done in accordance with OSHA requirements and the manufacturer's recommendations.

CPIH Name:

Signature/Date:

Asbestos Abatement Contractor's Name:

Signature/Date:

ATTACHMENT #2

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

DATE:

PROJECT NAME:

PROJECT ADDRESS:

ABATEMENT CONTRACTOR'S NAME:

WORKING WITH ASBESTOS CAN BE HAZARDOUS TO YOUR HEALTH. INHALING ASBESTOS HAS BEEN LINKED WITH VARIOUS TYPES OF CANCERS. IF YOU SMOKE AND INHALE ASBESTOS FIBERS YOUR CHANCES OF DEVELOPING LUNG CANCER IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer's contract with the owner for the above project requires that: You must be supplied with the proper personal protective equipment including an adequate respirator and be trained in its use. You must be trained in safe and healthy work practices and in the use of the equipment found at an asbestos abatement project. You must receive/have a current medical examination for working with asbestos. These things shall be provided at no cost to you. By signing this certificate you are indicating to the owner that your employer has met these obligations.

RESPIRATORY PROTECTION: I have been trained in the proper use of respirators and have been informed of the type of respirator to be used on the above indicated project. I have a copy of the written Respiratory Protection Program issued by my employer. I have been provided for my exclusive use, at no cost, with a respirator to be used on the above indicated project.

TRAINING COURSE: I have been trained by a third party, State/EPA accredited trainer in the requirements for an AHERA/OSHA Asbestos Abatement Worker training course, 32 hours minimum duration. I currently have a valid State accreditation certificate. The topics covered in the course include, as a minimum, the following:

- Physical Characteristics and Background Information on Asbestos
- Potential Health Effects Related to Exposure to Asbestos
- Employee Personal Protective Equipment
- Establishment of a Respiratory Protection Program
- State of the Art Work Practices
- Personal Hygiene
- Additional Safety Hazards
- Medical Monitoring
- Air Monitoring
- Relevant Federal, State and Local Regulatory Requirements, Procedures, and Standards
- Asbestos Waste Disposal

MEDICAL EXAMINATION: I have had a medical examination within the past 12 months which was paid for by my employer. This examination included: health history, occupational history, pulmonary function test, and may have included a chest x-ray evaluation. The physician issued a positive written opinion after the examination.

Signature:

Social Security Number:

Printed Name:

Witness:

ATTACHMENT #3

**AFFIDAVIT OF MEDICAL SURVEILLANCE, RESPIRATORY PROTECTION AND
TRAINING/ACCREDITATION**

VA PROJECT NAME AND NUMBER:

VA MEDICAL FACILITY:

ABATEMENT CONTRACTOR'S NAME AND ADDRESS:

1. I verify that the following individual

Name:

Social Security Number:

who is proposed to be employed in asbestos abatement work associated with the above project by the named Abatement Contractor, is included in a medical surveillance program in accordance with 29 CFR 1926.1101(m), and that complete records of the medical surveillance program as required by 29 CFR 1926.1101(m)(n) and 29 CFR 1910.20 are kept at the offices of the Abatement Contractor at the following address.

Address:

2. I verify that this individual has been trained, fit-tested and instructed in the use of all appropriate respiratory protection systems and that the person is capable of working in safe and healthy manner as expected and required in the expected work environment of this project.
3. I verify that this individual has been trained as required by 29 CFR 1926.1101(k). This individual has also obtained a valid State accreditation certificate. Documentation will be kept on-site.
4. I verify that I meet the minimum qualifications criteria of the VA specifications for a CPIH.

Signature of CPIH:

Date:

Printed Name of CPIH:

Signature of Contractor:

Date:

Printed Name of Contractor:

ATTACHMENT #4

**ABATEMENT CONTRACTOR/COMPETENT PERSON(S) REVIEW AND ACCEPTANCE OF THE
VA'S ASBESTOS SPECIFICATIONS**

VA Project Location:

VA Project #:

VA Project Description:

This form shall be signed by the Asbestos Abatement Contractor Owner and the Asbestos Abatement Contractor's Competent Person(s) prior to any start of work at the VA related to this Specification. If the Asbestos Abatement Contractor's/Competent Person(s) has not signed this form, they shall not be allowed to work on-site.

I, the undersigned, have read VA's Asbestos Specification regarding the asbestos abatement requirements. I understand the requirements of the VA's Asbestos Specification and agree to follow these requirements as well as all required rules and regulations of OSHA/EPA/DOT and State/Local requirements. I have been given ample opportunity to read the VA's Asbestos Specification and have been given an opportunity to ask any questions regarding the content and have received a response related to those questions. I do not have any further questions regarding the content, intent and requirements of the VA's Asbestos Specification.

At the conclusion of the asbestos abatement, I will certify that all asbestos abatement work was done in accordance with the VA's Asbestos Specification and all ACM was removed properly and no fibrous residue remains on any abated surfaces.

Abatement Contractor Owner's Signature

Date

Abatement Contractor Competent Person(s)

Date

Date

Date

- E N D -

SECTION 03 30 53

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.
- B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 TOLERANCES:

- A. ACI 117.
- B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E1155.

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.
- C. Shop Drawings: Reinforcing steel: Complete shop drawings.
- D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

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):
 - 117R-06.....Tolerances for Concrete Construction and Materials
 - 211.1-91(R2002).....Proportions for Normal, Heavyweight, and Mass Concrete

- 211.2-98(R2004).....Proportions for Structural Lightweight
Concrete
- 301-05.....Specification for Structural Concrete
- 305R-06.....Hot Weather Concreting
- 306R-2002.....Cold Weather Concreting
- SP-66-04ACI Detailing Manual
- 318/318R-05.....Building Code Requirements for Reinforced
Concrete
- 347R-04.....Guide to Formwork for Concrete
- C. American Society for Testing And Materials (ASTM):
- A185-07.....Steel Welded Wire, Fabric, Plain for
Concrete Reinforcement
- A615/A615M-08.....Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement
- A996/A996M-06.....Standard Specification for Rail-Steel and
Axle-Steel Deformed Bars for Concrete
Reinforcement
- C31/C31M-08.....Making and Curing Concrete Test Specimens
in the Field
- C33-07.....Concrete Aggregates
- C39/C39M-05.....Compressive Strength of Cylindrical
Concrete Specimens
- C94/C94M-07.....Ready-Mixed Concrete
- C143/C143M-05.....Standard Test Method for Slump of
Hydraulic Cement Concrete
- C150-07.....Portland Cement
- C171-07.....Sheet Material for Curing Concrete
- C172-07.....Sampling Freshly Mixed Concrete
- C173-07.Air Content of Freshly Mixed Concrete by the Volumetric
Method
- C192/C192M-07.....Making and Curing Concrete Test Specimens
in the Laboratory
- C231-08.....Air Content of Freshly Mixed Concrete by
the Pressure Method
- C260-06.....Air-Entraining Admixtures for Concrete
- C330-05.....Lightweight Aggregates for Structural
Concrete

C494/C494M-08.....Chemical Admixtures for Concrete

C618-08.....Coal Fly Ash and Raw or Calcined Natural
Pozzolan for Use in Concrete

D1751-04.....Preformed Expansion Joint Fillers for
Concrete Paving and Structural
Construction (Non-extruding and Resilient
Bituminous Types)

D4397-02.....Polyethylene Sheeting for Construction,
Industrial and Agricultural Applications

E1155-96(2008).....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 Project 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 300 mm (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. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil).
- J. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See structural drawings for grade.
- K. Welded Wire Fabric: ASTM A185.
- L. Expansion Joint Filler: ASTM D1751.
- M. Sheet Materials for Curing Concrete: ASTM C171.
- N. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- O. 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.

- P. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- Q. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout shall show no settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement, and produce a compressive strength of at least 18mpa (2500 psi) at 3 days and 35mpa (5000 psi) at 28 days.

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 25 mpa (3000 psi).
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.
- E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

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

- 1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
- 2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
- 3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
- * Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

- F. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS. Air content shall conform with 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
10 mm (3/8 in)	6 to 10
13 mm (1/2 in)	5 to 9
19 mm (3/4 in)	4 to 8
25 mm (1 in)	3 1/2 to 6 1/2
40 mm (1 1/2 in)	3 to 6

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

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

2.4 BATCHING & MIXING:

- A. Store, batch, and mix materials as specified in ASTM C94.
1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.
 2. 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.
 3. 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 conform 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: Flashing reglets, 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 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:

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:

Except where membrane waterproofing is required, place interior concrete slabs on a continuous vapor barrier.

- A. Place 100 mm (4 inches) of fine granular fill over the vapor barrier to act as a blotter for concrete slab.
- B. Lap joints 150 mm (6 inches) and seal with a compatible pressure-sensitive tape.
- C. Patch punctures and tears.

3.4 PLACING CONCRETE:

- A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying

equipment. Obtain approval of Project Engineer before placing concrete. Provide screeds at required elevations for concrete slabs.

- B. 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.
- C. 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 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (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.
- D. 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.
- E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from Project Engineer.

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 Project Engineer.

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 Project Engineer, 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 Project Engineer 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.

3. Interior and Exterior Exposed Areas (finished): Finished areas, unless otherwise shown, shall be given a grout finish of uniform color and shall have a smooth finish treated as follows:
 - a. After concrete has hardened and laitance, fins and burrs have been removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone or stone.
 - b. Apply grout composed of 1 part portland cement and 1 part clean, fine sand (smaller than 600 micro-m (No. 30) sieve). Work grout into surface of concrete with cork floats or fiber brushes until all pits and honeycomb are filled.
 - c. After grout has hardened, but still plastic, remove surplus grout with a sponge rubber float and by rubbing with clean burlap.
 - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish for any area in same day. Confine limits of finished areas to natural breaks in wall surface. Do not leave grout on concrete surface overnight.

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 ensure 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, future floor roof 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.

5. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.
6. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:

Slab on grade & Shored suspended slabs		Unshored suspended slabs	
Specified overall value	F _F 25/F _L 20	Specified overall value	F _F 25
Minimum local value	F _F 17/F _L 15	Minimum local value	F _F 17

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.
- C. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of all concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Aggregate shall be broadcast uniformly over concrete surface. Trowel concrete surface to smooth dense finish. After curing, rub the treated surface with abrasive brick and water sufficiently to slightly expose abrasive aggregate.

3.10 APPLIED TOPPING:

- A. Separate concrete topping with thickness and strength shown with only enough water to ensure a stiff, workable, plastic mix.
- B. Continuously place applied topping until entire section is complete, struck off with straightedge, compact by rolling or tamping, float and steel trowel to a hard smooth finish.

3.11 RESURFACING FLOORS:

Remove existing flooring, in areas to receive resurfacing, to expose existing structural slab and to extend not less than 25 mm (1 inch) below new finished floor level. Prepare exposed structural slab surface by roughening, broom cleaning, wetting, and grouting. Apply topping as specified.

3.12 RETAINING WALLS:

- A. Concrete for retaining walls shall be as shown and air-entrained.

- B. Install and construct expansion and contraction joints, waterstops, weep holes, reinforcement and railing sleeves as shown.
- C. Finish exposed surfaces to match adjacent concrete surfaces, new or existing.
- D. Porous backfill shall be placed as shown.

3.13 PRECAST CONCRETE ITEMS:

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

- - - E N D - - -

SECTION 03 52 72

EPOXIED STEEL DOWELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install epoxied steel dowels as indicated on the drawings and specified.

1.2 SUBMITTALS

- A. Submit descriptive data. The ICBO number or ICC-ES number, the manufacturer's catalog data in the form of catalog cuts may be submitted in lieu of drawings for the materials.
- B. Submit instructions for epoxy including: Storage requirements, mixing instructions; installation equipment and procedures; curing requirements; and restrictions to be adhered to in order to reduce hazards to personnel or to the environment.

PART 2 - PRODUCTS

2.1 EPOXIED STEEL DOWELS

- A. Materials shall be as indicated on the drawings, and part of a system that has been evaluated by ICBO or ICC-ES and has been approved for the application involved.
- B. Dowels: Provide bars conforming to ASTM A615, Grade 60, and of the size indicated on the drawings. Remove burrs and projections from bars. Coat sliding portion of each bar with shop applied paint.
- C. Epoxy: Provide a combination of epoxy resin binder, a mineral filler and a thixotropic agent used in cementing dowels in place.
 - 1. Conform to the requirements indicated on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install epoxied steel dowels in accordance with the manufacturer's recommendations, and in compliance with the ICBO number under which it was approved.

- - - E N D - - -

SECTION 03 65 40

FLOOR PATCHING AND LEVELING

PART 1 - GENERAL

1.1 SUMMARY

Furnish and install portland cement based self-leveling floor underlayment as indicated on the drawings, where depressions, holes, unevenness or other irregularities exist in the existing floor surface required to receive new finish flooring requiring a smooth and even substrate.

1.2 SUBMITTALS

- A. Product Data: Submit descriptive information. Provide physical characteristics, and product limitations.
- B. Manufacturer's Installation Instructions: Indicate mixing, application and, curing instructions.
- C. Manufacturer's Certificate: Certify that the proposed product meets or exceeds specified requirements.

1.3 QUALIFICATIONS

Applicator: The applicator shall be an organization specializing in performing the work of this Section with minimum 3 years documented experience and approved by manufacturer.

1.4 ENVIRONMENTAL REQUIREMENTS

Do not install underlayment until floor penetrations and peripheral work are complete. Maintain minimum ambient temperatures of 50 degrees F for 24 hours before, during and 72 hours after installation of underlayment. During the curing process, ventilate spaces to remove excess moisture.

PART 2 - PRODUCTS

2.1 FLOOR PATCHING AND LEVELING MATERIALS

- A. Subject to compliance with specified requirements, provide self-leveling portland cement based floor patching and leveling materials of one of the following (or equal):
 - 1. Ardex, Inc., Ardex K-15.
 - 2. Gyp-Crete Corporation, Level-Right.
 - 3. Quikrete Companies, Normal Set No. 1249-50.
- B. Underlayment: Provide portland cement based mix.
- C. Primer: Provide manufacturer's recommended type.
- D. Joint and Crack Filler: Latex based.

- E. Site mix materials in accordance with manufacturer's instructions. Mix to achieve following characteristics:
 - 1. Density: 115 lb/cu ft minimum dry density.
 - 2. Compressive Strength: 2500 psi at 28 days minimum in accordance with ASTM C472.
 - 3. Fire Hazard Classification: 0/0/0 (Flame/Fuel/Smoke) rating in accordance with ASTM E286.
- F. Mix to consistency to achieve self-leveling.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum by-products, or other compounds detrimental to underlayment material bond to substrate.
- B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- C. Vacuum clean surfaces.

3.2 INSTALLATION

- A. Install the self-leveling underlayment in accordance with manufacturer's instructions. Place to thickness required to provide a smooth, even substrate suitable for the finish flooring material to be superimposed upon the portland cement based underlayment. The minimum thickness shall not be less than recommended by the manufacturer. Install before partition installation.
- B. Air cure in accordance with manufacturer's instructions.

3.3 APPLICATION TOLERANCE

Maintain top surface level to 1/8 inch in 10 ft.

3.4 PROTECTION OF FINISHED WORK

Protect finished Work from damage. Do not permit traffic over unprotected floor surface.

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0SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Painting: Section 09 91 00, PAINTING.
- C. Steel Joist: Section 05 21 00, STEEL JOIST FRAMING.
- D. Steel Decking: Section 05 31 00, STEEL DECKING.
- E. Composite Steel Deck: Section 05 36 00, COMPOSITE METAL DECKING.
- F. Fireproofing: Section 07 81 00, APPLIED FIREPROOFING.

1.3 QUALITY ASSURANCE:

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

1.4 TOLERANCES:

Fabrication tolerances for structural steel shall be held within limits established by ASTM A6, by Section 7, Code of Standard Practice for Buildings and Bridges, and by Standard Mill Practice - General Information (AISC LRFD Manual, Second Edition, Page 1-183), except as follows:

- A. Elevation tolerance for column splice points at time member is erected is 10 mm (3/8 inch).
- B. Elevation tolerance for top surface of steel beams and girders at connections to columns at time floor is erected is 13 mm (1/2 inch).
- C. Elevation tolerance for closure plates at the building perimeter and at slab openings prior to concrete placement is 6 mm (1/4 inch).

1.5 SHOP DRAWINGS

- A. Connections: Detail all pieces and connections for each member size, steel grade and connection type indicated on the drawings. Use details consistent with the details shown on the Drawings, supplementing where

necessary. The details shown on the Drawings are conceptual and do not indicate the required weld sizes or number of bolts unless specifically noted. Use standard practice in detailing. Shop drawings and the detailing of all connections are subject to the review and acceptance of the Structural Engineer.

1.6 REGULATORY REQUIREMENTS:

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

1.7 SUBMITTALS:

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

1.8 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Institute of Steel Construction (AISC):
 - 1. Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design (Ninth Edition, 1989)
 - 2. Load and Resistance Factor Design Specification for Structural Steel Buildings (Second Edition, 1995)
 - 3. Code of Standard Practice for Steel Buildings and Bridges (March 2000).
- C. American National Standards Institute (ANSI):
 - B18.22.1-98.....Plain Washers
 - B18.22M-00.....Metric Plain Washers
- D. American Society for Testing and Materials (ASTM):
 - A6/A6M-02.....Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

- A36/A36M-01.....Standard Specification for Carbon Structural Steel
- A53/A53M-01.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- A123/A123M-02.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- A242/A242M-01.....Standard Specification for High-Strength Low-Alloy Structural Steel
- A283/A283M-00.....Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
- A307-00.....Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- A325-02.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- A490-02.....Standard Specification for Heat-Treated Steel Structural Bolts 150 ksi Minimum Tensile Strength
- A500-01.....Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- A501-01.....Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
- A572/A572M-01.....Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- A992/A992M-02.....Standard Specification for Structural Steel Shapes
- E. American Welding Society (AWS):
- D1.1-02.....Structural Welding Code-Steel
- F. Research Council on Structural Connections (RCSC) of The Engineering Foundation:
- Specification for Structural Joints Using ASTM A325 or A490 Bolts
- G. Military Specifications (Mil. Spec.):
- MIL-P-21035.....Paint, High Zinc Dust Content, Galvanizing, Repair
- H. Occupational Safety and Health Administration (OSHA):
- 29 CFR Part 1926-2001...Safety Standards for Steel Erection

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Structural Steel: ASTM A36, A992.
- B. Structural Tubing: ASTM A500, Grade B.

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

PART 3 - EXECUTION

3.1 CONNECTIONS (SHOP AND FIELD):

- A. Welding: Welding in accordance with AWS D1.1. Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.1 to perform type of work required.
- B. High-Strength Bolts: High-strength bolts tightened to a bolt tension not less than proof load given in Specification for Structural Joints Using ASTM A325 or A490 Bolts. Tightening done with properly calibrated wrenches, by turn-of-nut method or by use of direct tension indicators (bolts or washers). Tighten bolts in connections identified as slip-critical using Direct Tension Indicators or the turn-of-the-nut method. Twist-off torque bolts are not an acceptable alternate fastener for slip critical connections.

3.2 FABRICATION:

Fabrication in accordance with Chapter M, Specification for Steel Buildings - Load and Resistance Factor Design.

3.3 SHOP PAINTING:

- A. General: Shop paint steel with primer in accordance with Section 6, Code of Standard Practice for Steel Buildings and Bridges.
- B. Shop paint for steel surfaces is specified in Section 09 91 00, PAINTING.
- C. Do not apply paint to following:
 - 1. Surfaces within 50 mm (2 inches) of joints to be welded in field.
 - 2. Surfaces which will be encased in concrete.
 - 3. Surfaces which will receive sprayed on fireproofing.
 - 4. Top flange of members which will have shear connector studs applied.
- D. Structural steel in the interstitial space that does not receive sprayed on fireproofing shall be painted with primer in accordance with general requirement of shop painting.
- E. Zinc Coated (Hot Dip Galvanized) per ASTM A123 (after fabrication):
Touch-up after erection: Clean and wire brush any abraded and other

spots worn through zinc coating, including threaded portions of bolts and welds and touch-up with galvanizing repair paint.

3.4 ERECTION:

- A. General: Erection in accordance with Section 7, Code of Standard Practice for Steel Buildings and Bridges.
- B. Temporary Supports: Temporary support of structural steel frames during erection in accordance with Section 7, Code of Standard Practice for Steel Buildings and Bridges.

3.5 FIELD PAINTING:

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

3.6 SURVEY:

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

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SECTION 05 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. Exterior load-bearing steel stud walls.
2. Interior load-bearing steel stud walls.
3. Exterior non-load-bearing steel stud curtain wall.
4. Steel joists.
5. Steel trusses.

1.2 RELATED WORK:

- A. Structural steel framing: Section 05 12 00, STRUCTURAL STEEL FRAMING.
- B. Non-load-bearing metal stud framing assemblies: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.
- C. 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 with the minimum physical and structural properties indicated.
- C. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.
1. Design Loads: Exterior walls - wind loads as indicated; interior partitions - 5 psf out-of-plane seismic load .
 2. Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Load-Bearing Walls: Lateral deflection of 1/240 of the wall height.

- b. Interior Load-Bearing Walls: Lateral deflection of $1/240$ of the wall height.
 - c. Exterior Non-load-Bearing Curtain wall: Lateral deflection of $1/240$ of the wall height.
 - d. Floor Joists: Vertical deflection of $1/240$ of the span.
 - e. Roof Trusses: 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 67 degrees C (120 degrees F).
 - 4. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
 - 5. Design exterior non-load-bearing curtain wall framing to accommodate lateral deflection without regard to contribution of sheathing materials.
 - 6. 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(REV. A)-2003...Standard Specifications for Carbon Structural
Steel

A123/A123M-2002.....Standard Specifications for Zinc (Hot-Dip
Galvanized) Coatings on Iron and Steel Products

A153/A153M-2003.....Standard Specifications for Zinc Coating (Hot-
Dip) on Iron and Steel Hardware

A307-2002.....Standard Specifications for Carbon Steel Bolts
and Studs

A653/A653M-2003.....Standard Specifications for Steel Sheet, Zinc-
Coated (Galvanized) or Zinc-Iron Alloy-Coated
(Galvannealed) by the Hot-Dip Process

C955-2003.....Standard Specifications for Load-Bearing
(Transverse and Axial) Steel Studs, Runners
(Tracks), and Bracing or Bridging for Screw
Application of Gypsum Panel Products and Metal
Plaster Bases

C1107-2002.....Standard Specifications for Packaged Dry,
Hydraulic-Cement Grout (Non-shrink)

E488-96(Reapproved 2003)Standard Test Methods for Strength of Anchors
in Concrete and Masonry Elements

E1190-95(Reapproved 2000)Standard Test Methods for Strength of Power-
Actuated Fasteners Installed in Structural
Members

D. American Welding Society (AWS):

D1.3-(98).....Structural Welding Code-Sheet Steel

E. Military Specifications (Mil. Spec.):

MIL-P-21035B(Reinst. Notice 2) 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 (50 ksi) 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 (33 ksi) minimum.
- C. Galvanizing Repair Paint: MIL-P-21035B.
- D. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, with fluid consistency and a 30 minute working time.

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 following:
 - 1. Design Uncoated-Steel Thickness:
 - 0.91 mm (0.0358 inch)
 - 1.20 mm (0.0474 inch)
 - 1.52 mm (0.0598 inch)
 - 1.90 mm (0.0747 inch)
 - 2.66 mm (0.1046 inch)
 - 2. Flange Width:
 - 41 mm (1-5/8 inches) minimum
 - 3. Web: Punched
- 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 following:

1. Design Uncoated-Steel Thickness:

0.91 mm (0.0358 inch)

1.20 mm (0.0474 inch)

1.52 mm (0.0598 inch)

1.90 mm (0.0747 inch)

2.66 mm (0.1046 inch)

2. Flange Width:

41 mm (1-5/8 inches) minimum

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. Flange Width: 41 mm (1 5/8-inches) minimum.

2.4 FRAMING ACCESSORIES:

A. Fabricate steel framing accessories of the same material and finish used for framing members, with a minimum yield strength of 230 MPa (33 ksi).

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 two 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 3 mm (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 3 mm (1/8 inch) +/- out of square within the length of that panel.

3.4 FIELD REPAIR:

Touch-up damaged galvanizing with galvanizing repair paint.

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SECTION 05 50 00

METAL FABRICATION

PART 1 - GENERAL

1.1 DESCRIPTION

This section covers items and assemblies fabricated from structural steel shapes and other materials as shown and specified.

1.2 SUBMITTALS

In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, furnish the following:

- A. Shop Drawings: For each item specified in the contract provide shop drawings 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. Mark items requiring field assembly for erection identification and furnish erection drawings and instructions.

1.3 APPLICABLE PUBLICATIONS

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

- B. Federal Specifications (Fed. Spec.):

FF-B-588C(1).....Bolt, Toggle; And Expansion Sleeve, Screw

FF-P-395B.....Pin, Drive, Guided And Pin Drive, Power
Actuated (Fasteners For Powder Actuated
And Hand Actuated Fastening Tools)

FF-S-325Shield, Expansion; Nail, Expansion; And
Nail, INT AMD 3 Drive Screw (Devices,
Anchoring, Masonry)

QQ-A-200/9C(1).....Aluminum Alloy Bar, Rod, Shapes, Tube And
Wire, Extruded, 6063

QQ-F-461C(1).....Floor, Plate, Steel, Rolled

QQ-S-775E.....Steel, Sheets, Carbon, Zinc-Coated

RR-T-650B.....Treads, Metallic And Non-Metallic, Non-
Skid

TT-P-641G(1).....Primer Coating, Zinc Dust-zinc Oxide (For
Galvanized Surfaces)

TT-P-645A.....Primer, Paint Zinc Chromate, Alkyd Type

WW-P-406D.....Pipe, Steel (Seamless And Welded)

- C. Military Specifications (Mil. Spec.):

MIL-P-21035(SHIPS).....Paint, High Zinc Dust Content, Galvanizing
Repair

- D. American Society for Testing and Materials (ASTM):
 - A36-81.....Structural Steel
 - A307.....Low-carbon steel externally and internally
threaded standard fasteners
- E. American Welding Society (AWS):
 - D1.1-81.....Structural Welding Code
- F. Structural Steel Painting Council (SSPC):
 - SSPC-SP 1-63.....No. 1, Solvent Cleaning
 - SSPC-SP 2-63.....No. 2, Hand Tool Cleaning
 - SSPC-SP 3-63.....No. 3, Power Tool Cleaning

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel: ASTM A36.
- B. Threaded Rods: ASTM A36.
- C. Machine Bolts: ASTM A307 Low-carbon steel externally and internally threaded standard fasteners.
- D. Power Actuated Drive Pins: Fed. Spec. FF-P-395, style to suit material.
- E. Expansion Bolts (Shields): Fed. Spec. FF-S-325, except lead, fiber and plastic shields are not acceptable. Furnish bolts and screws required.
- F. Toggle Bolts: Fed. Spec. FF-B-588, except wire wings are not acceptable.
- G. Zinc Chromate Primer: Fed. Spec. TT-P-645, Type II.
- H. Zinc Dust Primer: Fed. Spec. TT-P-641, Type II.
- I. Zinc Rich Paint: Mil. Spec. MIL-P-21035.

2.2 FABRICATION GENERAL

- A. Material: Material shall be as specified. Material required which is not named or which is named but for which a standard of quality is not specified shall be of good commercial quality, suitable in all respects for the intended purpose.
 - 1. Material shall be free of defects which affect the appearance of serviceability of the finished product.
- B. Size: Size and thickness of members shall be as shown. When size and thickness is not specified or shown for an individual part, the size and thickness shall be not less than that used for the

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

- C. Connections: Except as otherwise specified, connections may be made by welding, riveting or bolting. Field riveting will not be approved.
1. Holes, for bolts shall be accurately punched or drilled, and shall have the burrs removed. Size, number and placement of rivets and bolts, shall be designed so as to develop a joint strength of not less than the design value.
 2. Welding shall be in accordance with AWS D1.1. Welds shall be of sufficient size and shape to develop the full design strength of the parts connected by welds and shall transmit imposed stresses without permanent deformation or failure when subject to service loadings.
 3. Bolts shall be of material selected to prevent corrosion (electrolysis) at bimetallic contacts. Plated or coated material will not be approved.
- D. Fasteners and Anchors: Methods for fastening or anchoring metal fabrications to building construction shall be as shown or specified. Where fasteners and anchors are not shown, the type, size, location and spacing shall be designed so as to resist the loads imposed without deformation of the members or causing failure of the anchor or fastener, and shall suit the sequence of installation. The material and finish of the fasteners shall be compatible with the kinds of materials which are fastened together and their location in the finished work.
1. Fasteners for securing metal fabrication to existing construction or new construction may be by expansion bolts, toggle bolts, power actuated drive pins, welding, self drilling and tapping screws or bolts.
- E. Workmanship:
1. General: Fabricate items to design shown. Furnish members in longest lengths commercially available within the limits shown and specified. All work shall be straight, true, free from warp and twist, and where applicable square and in same plane.
 - a. Provide holes, sinkages and reinforcement shown and required for fasteners and anchorage items. Provide openings, cut-outs and tapped holes for attachment and clearances required for work of other trades. Prepare members for the installation and fitting of hardware.
 - b. All surfaces and edges shall be free from sharp edges, burrs and projects which may cause injury.
 2. Welding: Welding shall be in accordance with the requirements of AWS D1.1. Welds shall show good fusion, be free from cracks and porosity and accomplish secure and rigid joints in proper alignment. Where exposed in the finished work, welds shall be continuous for the full length of the members joined and have depressed areas filled and

all protruding welds finished smooth and flush with adjacent surfaces.

3. Joining: Miter or butt members at corners. Where frames members are butted at corners, cut leg of frame member perpendicular to surface, as required for clearance.
4. Cutting and Fitting: All joints, corners, copes, and miters shall be accurately cut, machined and fitted. Removable members shall be fitted so as to be easily removed.
 - a. Design and construct field connections in the most practical place for appearance and ease of installation. All pieces shall fit together as required. Connections shall provide ease of assembly (and disassembly) without use of special tools. Joints shall be firm when assembled.
 - b. Joining, fitting and welding on exposed work shall be concealed as far as practical. Rivets and screws shall not show prominently on the exposed face.
 - c. The fit of components and the alignment of holes shall eliminate the need to modify any component or to use exceptional force in the assembly of any item and shall eliminate the need to use other than common tools.

F. Finish:

1. Steel and Iron:

- a. Shop Prime Painting: All surfaces of steel and iron except surfaces to be welded and zinc coated (galvanized) surfaces shall be cleaned of all oil, grease, soil and other detrimental matter by use of solvents or cleaning compounds as defined in SSPC-SP1. Remove all loose mill scale, rust, and paint, by hand or power tool cleaning as defined in SSPC-SP2 and SP3. Surfaces exposed in the finished work shall have all holes, dents and similar voids and depressions filled with epoxy type patching compound and all projections and rough surfaces finished smooth. After cleaning and finishing, apply one coat of zinc-chromate primer.
- b. Spot prime all abraded and damaged areas of zinc coating which expose the bare metal, using zinc rich paint on hot-dip zinc coated items and zinc dust primer on all other zinc coated items.
- c. Finish painting of exposed surfaces is specified elsewhere.

- G. Protection: Insulate aluminum surfaces that will come in contact with metals other than stainless steel, zinc or white bronze by giving the dissimilar metal a coat of heavy-bodied alkali resisting bituminous paint. Insulate aluminum from plaster, masonry and concrete by painting the aluminum with zinc-chromate primer.

2.3 SUPPORTS

- A. General: Fabricate of structural steel shapes as shown. Provide clip angles or make provisions for welding hangers and braces to overheads construction. Field connections may be welded or bolted.
- B. Supports for Wall Mounted Items: Where items are supported by metal stud partitions provide supports as follows:
 - 1. 16 gauge steel hat channels.

2.4 STEEL RAILINGS AND HANRAILS

- A. Provide steel handrails, including inserts in concrete, [steel pipe conforming to ASTM A 53/A 53M or structural tubing conforming to ASTM A 500/A 500M, Grade A or B of equivalent strength. Provide steel railings of the nominal size indicated on the drawings. Railings to be hot-dip galvanized and shop painted.
 - 1. Fabrication: Joint posts, rail, and corners by one of the following methods:
 - a. Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.
 - b. Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railings splices and reinforce them by a tight fitting interior sleeve not less than 6 inches long.
 - c. Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe in not crushed.

2.5 GUARD POSTS (BOLLARDS/PIPE GUARDS)

Provide galvanized and prime coated, standard weight steel pipe as specified in ASTM A 53/A 53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2000 psi.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation of metal fabrications shall be by experienced mechanics capable of installing each item in accordance with the drawings and specifications, in consideration of the field conditions, and the shop and erection drawings.
- B. 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.
- C. Furnish setting drawings and instructions for installation of anchors to be preset into concrete and for the positioning of items having anchors to be built into concrete.

- D. Set frames of gratings, covers, corner guards, trap doors and similar items flush with finish floor or wall surface and, where applicable, flush with side of opening.
- E. Field welding shall be in accordance with AWS D1.1 and shall be designed and finished as specified for shop welding.
- F. Provide 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.
- G. 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.

3.2 CLEANING AND ADJUSTING

- A. All movable parts including hardware shall be cleaned and adjusted to operate as designed without binding or deformation of the members, to be centered in the opening or frame and, where applicable, to have all contact surfaces fit tight and even without forcing or warping the components.

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SECTION 06 20 00

FINISH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies exterior and interior millwork as indicated on the drawings and specified.

1.2 RELATED WORK

- A. Fabricated Metal brackets, bench supports and countertop legs: Section 05 50 00, METAL FABRICATIONS.
- B. Color and texture of finish: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Stock Casework: Section 12 32 00, MANUFACTURED WOOD CASEWORK.

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: Solid surface fabrications, and Plastic laminate finished plywood or particleboard, 150 mm by 300 mm (six by twelve inches).
- D. Certificates: provide Woodwork Institute (WI) certified Compliance Certificate attesting that finish carpentry complies with the specifications.

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 Project Engineer. Store at a minimum temperature of 21°C (70°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
 - A53-07..... 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
 - E84-09..... 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
 - A156.11-04..... Cabinet Locks
 - A156.16-02..... Auxiliary Hardware
- E. Hardwood Plywood and Veneer Association (HPVA):
 - HP1-09..... Hardwood and Decorative Plywood
- F. National Particleboard Association (NPA):
 - A208.1-99..... Wood Particleboard
- G. American Wood-Preservers' Association (AWPA):
 - AWPA C1-03..... All Timber Products - Preservative Treatment by
Pressure Processes
- H. Architectural Woodwork Institute (AWI):
 - AWI-99..... Architectural Woodwork Quality Standards and
Quality Certification Program
- I. National Electrical Manufacturers Association (NEMA):
 - LD 3-05..... High-Pressure Decorative Laminates
- J. U.S. Department of Commerce, Product Standard (PS):
 - PS20-05..... American Softwood Lumber Standard
- K. Military Specification (Mil. Spec):
 - MIL-L-19140E... Lumber and Plywood, Fire-Retardant Treated

- L. 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.
- E. Use edge grain Wood members exposed to weather.

2.2 PLYWOOD

- A. Softwood Plywood:
 - 1. Prod. Std.
 - 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, 13 mm (1/2 inch) and thicker; not less than five ply construction, except 32 mm (1-1/4 inch) thick plywood not less than seven 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.
 - b. Use Type II (interior) Sound Grade veneer for paint finish.
 - 4. On Outside of Building:
 - a. Use Type I, (exterior) A Grade veneer for natural or stained and varnish finish.
 - b. Use Type I, (exterior) Sound Grade veneer for paint finish.
 - 5. Use plain sliced red oak or rotary cut white birch, unless indicated otherwise.

2.3 PARTICLEBOARD

- A. NPA A208.1
- B. Plastic Laminate Particleboard Cores:

1. Use Type 1, Grade 1-M-3, or Type 2, Grade 2-M-2, unless otherwise specified.
 2. Use Type 2, Grade 2-M-2, exterior bond, for tops with sinks.
- C. General Use: Type 1, Grade 1-M-3 or Type 2, Grade 2-M-2.

2.4 PLASTIC LAMINATE

- A. Plastic laminate shall be Wilsonart as indicated or as selected by the Architect from products by one of the following:
1. Formica
 2. Laminart
 3. Westinghouse
 4. Pionite
- B. NEMA LD-3.
- C. Exposed decorative surfaces including countertops, both sides of cabinet doors, and for items having plastic laminate finish. General Purpose, Type HGL.
- D. 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 particle board.
- E. Backing sheet on bottom of plastic laminate covered wood tops: Backer, Type HGP.
- F. Post Forming Fabrication, Decorative Surfaces: Post forming, Type HGP.

2.5 SOLID SURFACING MATERIALS

- A. Subject to compliance with specified requirements, solid surfacing materials shall be Formica and Avonite Solid Surface, or an "or equal" product of E. I. du Pont de Nemours & Co., Inc., and of the dimensions and profiles indicated on the drawings. Other manufacturers offering "or equal" products are Wilsonart, and Nevamar.
- B. Joint adhesive: Provide the manufacturer's recommended adhesive for inconspicuous non-porous joints.
- C. Sealant: Provide the manufacturer's recommended silicone adhesive in colors closely matching the solid surfacing.
- D. Polishing cream: compatible polishing cream to achieve specified sheen.
- E. Core framing: Softwood lumber, clear and free of knots
- F. hardware: Provide stainless steel inserts, screws, flat washers, wing nuts, and clips required to make the installation complete.
- G. Adhesive for Plastic Laminate: Fed. Spec. A-A-1936.

- H. For Interior Millwork: Unextended urea resin, unextended melamine resin, phenol resin, or resorcinol resin.

2.6 STAINLESS STEEL

ASTM A167, Type 302 or 304.

2.7 ALUMINUM CAST

ASTM B26

2.8 ALUMINUM EXTRUDED

ASTM B221

2.9. HARDWARE

- A. Finish Hardware: match the existing as closely as practicable.

1. Cabinet Hardware: ANSI A156.9.

- a. Door/Drawer Pulls: B02011. Door in seismic zones: B03182.
- b. Drawer Slides: B05051 for drawers over 150 mm (6 inches) deep, B05052 for drawers 75 mm to 150 mm 3 to 6 inches) deep, and B05053 for drawers less than 75 mm (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.

2.10 MOISTURE CONTENT

- A. Moisture content of lumber and millwork at time of delivery to site.
 1. Interior finish lumber, trim, and millwork 32 mm (1-1/4 inches) or less in nominal thickness: 12 percent on 85 percent of the pieces and 15 percent on the remainder.
 2. Moisture content of other materials shall be in accordance with the standards under which the products are produced.

2.11 FABRICATION

- A. General:
 1. Except as otherwise specified, use WI 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 13 mm (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 4 m (14 feet) in length from one piece of lumber, back channeled and molded as shown.
 7. Interior trim and items of millwork to be painted may be fabricated from jointed, built-up, or laminated members, unless otherwise shown on drawings or specified.
 8. Plastic Laminate Work:
 - a. Factory glued to either a plywood or a particle board 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 19 mm (3/4-inch) molded thick or thinner core material.
 - c. Provide plastic backing sheet on underside of countertops, vanity tops, thru-wall counter including back splashes and end splashes of countertops.
 - d. Use backing sheet on concealed large panel surface when decorative face does not occur.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

- A. Maintain work areas and storage areas to a minimum temperature of 21°C (70°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 is 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. 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 600 mm (24 inch) centers between ends.
 - a. Nail Shelf to mounting strip at ends and to back wall strip at not over 900 mm (36 inches) on center.
 - b. Install metal bracket, ANSI A156.16, B04041, not over 1200 mm (4 feet) centers when shelves exceed 1800 mm (6 feet) in length.
 - c. Install metal bracket, ANSI A156.16, B04051, not over 1200 mm (4 feet) on centers where shelf length exceeds 1800 mm (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 900 mm (36 inches) on center and within 13 mm (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 07 21 13

THERMAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes thermal and acoustical insulation for buildings.
- B. Acoustical insulation is identified by thickness and words "Acoustical Insulation".

1.2 SUBMITTALS

- A. In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, furnish the following:
 - 1. Manufacturer's Literature and Data:
 - a. Thermal insulation, each type used
 - b. Adhesive, each type used.
 - c. Tape
 - 2. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.3 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.

1.4 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 basic designation only.
- B. Federal Specifications (Fed. Spec.)
 - FF-N-105B(3).....Nails, Brads, Staples And Spikes: Wire,
Cut And Wrought
- C. American Society of Testing and Materials (ASTM):
 - C270-86a.....Mortar for Unit Masonry
 - C516-75.....Vermiculite Loose Fill Insulation
 - C549-81.....Perlite Loose Fill Insulation
 - C552-79.....Cellular Glass Block and Pipe Thermal
Insulation

C553-70.....	Mineral Fiber Blanket and Felt Insulation (Industrial Type)
C578-85.....	Preformed Cellular Polystyrene Thermal Insulation
C591-83.....	Unfaced Preformed Rigid Cellular Polyurethane Thermal Insulation
C612-83.....	Mineral Fiber Block and Board Thermal Insulation
C665-84.....	Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
C728-82.....	Perlite Thermal Insulation Board
C954-86.....	Steel Drill Screws for the Application of Gypsum Board Metal Plaster Base to Steel Studs From 0.033 inch to 0.112 inch in thickness
D312-71.....	Asphalt For Use in Constructing Built-up Roof Coverings

PART 2 - PRODUCTS

2.1 INSULATION - GENERAL

- A. Where thermal resistance ("R" value) 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 thermal resistance specified.
- B. Where "R" value is not specified for insulation, use the thickness shown on the drawings.
- C. 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 EXTERIOR FRAMING OR FURRING INSULATION

- A. Batt or Blanket: Optional.
- B. Mineral Fiber: ASTM C665, Type II, Class C where framing is faced with gypsum board.
- C. Mineral Fiber: ASTM C665, Type III, Class A where framing is not faced with gypsum board.

2.3 ACOUSTICAL INSULATION

- A. Mineral Fiber: ASTM C553, Type II, flexible, or Type III, semirigid (4.5 pound nominal density).
- B. Thickness as shown; of widths and lengths to fit tight against framing.

2.4 SOUND DEADENING BOARD

- A. Mineral Fiber Board: ASTM C612, Class I, 1/2-inch thick
- B. Perlite Board: ASTM C728, 1/2-inch thick.

2.5 RIGID INSULATION

- A. On the inside face of exterior walls, spandrel beams, floors and where shown.
- B. Mineral Fiber Board: ASTM C612, Class 1 or 2.
- C. Perlite Board: ASTM C728.
- D. Cellular Glass Block: ASTM C552, Type I.

2.6 FASTENERS

- A. Staples or Nails: Fed. Spec. F-N-105, zinc-coated, size and type best suited for purpose.
- B. Screws: ASTM C954, size and length best suited for purpose with washer not less than two inches in diameter.
- C. Impaling Pins: Steel pins with head not less than two 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.

2.7 ADHESIVE

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

2.8 TAPE

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

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install insulation with the vapor barrier facing the heated side, unless specified otherwise.
- B. Install rigid insulating units with joints close and flush, in regular courses and with cross joints broken.
- C. Install batt or blanket insulation with tight joints and filling framing void completely. Seal cuts, tears, and unlapped joints with tape.
- D. Fit insulation tight against adjoining construction and penetrations, unless specified otherwise.

3.2 EXTERIOR FRAMING OR FURRING BLANKET INSULATION

- A. Pack insulation around door frames and windows and in building expansion joints, door soffits and other voids. Open voids are not permitted. Hold insulation in place with pressure sensitive tape.
- B. Lap vapor retarder flanges together over face of framing for continuous surface. Seal all penetrations through the insulation.
- C. Fasten blanket insulation between metal studs or framing and exterior wall furring by continuous pressure sensitive tape along flanged edges.
- D. Fasten blanket insulation between wood studs or framing with nails or staples through flanged edges on face of stud. Space fastenings not more than six inches apart.
- E. Roof Rafter Insulation or Floor Joist Insulation: Place mineral fiber blankets between framing to provide not less than a two inch air space between insulation and roof sheathing or subfloor.
- F. Ceiling Insulation and Soffit Insulation:
 - 1. Fasten blanket insulation between wood framing or joist with nails or staples through flanged edges of insulation.
 - 2. At metal framing or ceilings suspension systems, install blanket insulation above suspended ceilings or metal framing at right angles to the main runners or framing. Tape insulation tightly together so no gaps occur and metal framing members are covered by insulation.
 - 3. In areas where suspended ceilings adjoin areas without suspended ceilings, install either blanket, batt, or mineral fiberboard extending from the suspended ceiling to underside of deck or slab above. Secure in place to prevent collapse or separation of hung blanket, batt, or board insulation and maintain in vertical position. Secure blanket or batt with continuous cleats to structure above.

3.3 RIGID INSULATION ON SURFACE OF EXTERIOR WALLS, FLOORS, AND UNDERSIDE OF FLOORS

- A. On the interior face of solid masonry and concrete walls, beams, beam soffits, underside of floors, and to the face of studs for interior wall finish where shown.
- B. Bond to solid vertical surfaces with adhesive as recommended by insulation manufacturer. Fill joints with adhesive cement.
- C. Use impaling pins for attachment to underside of horizontal surfaces. Space fastenings as required to hold insulation in place and prevent sagging.
- D. Fasten board insulation to face of studs with screws, nails or staples. Space fastenings not more than 12 inches apart. Stagger fasteners at joints of boards. Install at each corner.
- E. Floor insulation:

1. Bond insulation to concrete floors in attic by coating surfaces with hot steep asphalt applied at rate of not less than 25 pounds per 100 square feet, and firmly bed insulation therein.
2. When applied in more than one layer, bed succeeding layers in hot steep asphalt applied at the rate of not less than 25 pounds per 100 square feet.
3. Contractors option: Insulation may be installed with nonflammable adhesive in accordance with the manufacturer's printed instructions when a separate vapor retarder is used.

3.4 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 sound deadening board is shown, secure with adhesive to masonry or concrete walls and with screws to metal or wood framing. Secure sufficiently in place until subsequent cover is installed. Seal all cracks with caulking.

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SECTION 07 21 17

ACOUSTICAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 SUBMITTALS

- A. In accordance with Section 01340, SAMPLES AND SHOP DRAWINGS, furnish the following:
 - 1. Manufacturer's Literature and Data:
 - a. Acoustical insulation, each type used
 - b. Adhesive, each type used.
 - c. Tape
 - 2. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.3 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.

1.4 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 basic designation only.
- B. Federal Specifications (Fed. Spec.)

FF-N-105B(3).....Nails, Brads, Staples And Spikes: Wire, Cut And Wrought
- C. American Society of Testing and Materials (ASTM):

C553-70.....Mineral Fiber Blanket and Felt Insulation
(Industrial Type)

C578-85.....Preformed Cellular Polystyrene Thermal
Insulation

C591-83.....Unfaced Preformed Rigid Cellular Polyurethane
Thermal Insulation

C612-83.....Mineral Fiber Block and Board Thermal Insulation

C665-84.....Mineral Fiber Blanket Thermal Insulation for
Light Frame Construction and Manufactured
Housing

C954-86.....Steel Drill Screws for the Application of Gypsum
Board Metal Plaster Base to Steel Studs From
0.033 inch to 0.112 inch in thickness

PART 2 - PRODUCTS

2.1 ACOUSTICAL INSULATION

- A. Mineral Fiber: ASTM C553, Type II, flexible, or Type III, semirigid (4.5 pound nominal density).
- B. Thickness as shown; of widths and lengths to fit tight against framing.

2.2 SOUND DEADENING BOARD

- A. Mineral Fiber Board: ASTM C612, Class I, 1/2-inch thick
- B. Perlite Board: ASTM C728, 1/2-inch thick.

2.3. FASTENERS

- A. Staples or Nails: Fed. Spec. F-N-105, zinc-coated, size and type best suited for purpose.
- B. Screws: ASTM C954, size and length best suited for purpose with washer not less than two inches in diameter.
- C. Impaling Pins: Steel pins with head not less than two 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 0.50.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install insulation with the vapor barrier facing the heated side, unless specified otherwise.
- B. Install rigid insulating units with joints close and flush, in regular courses and with cross joints broken.

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

3.1 INSTALLATION OF 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 sound deadening board is shown, secure with adhesive to masonry or concrete walls and with screws to metal or wood framing. Secure sufficiently in place until subsequent cover is installed. Seal all cracks with caulking.

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SECTION 07 81 05

SPRAYED-ON FIREPROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section covers the application of sprayed-on cementitious fireproofing as required for Type I construction as specified in the California Building Code (CBC).
- B. Apply fireproofing material on interior structural steel members where removal of such fireproofing has been removed.

1.2 TESTS

- A. Sprayed-on fireproofing material shall have been tested for fire endurance by a nationally recognized laboratory in accordance with ASTM E119, or NFPA 251, or UL 263 for each fire rating specified.
- B. Surface Burning Characteristics: Prepare test specimen of fireproofing materials in accordance with Fed. Spec. SS-S-111. Test for flame spread, fuel contributed and smoke developed, and report results in accordance with ASTM E84.
- C. Field Tests: Tests for thickness and density shall be in accordance with ASTM CE605.
 - 1. Tests for thickness and density of applied material will be performed by Contractor.
 - 2. Project Engineer will select areas to be tested in specific bays on each floor using a geometric grid pattern. Areas showing thickness less than that required as a result of fire endurance test will be rejected.
- D. When tested for fire endurance and surface burning characteristics, fireproofing material shall be tested using the adhesive and sealer to be supplied under the contract.

1.3 SUBMITTALS

- A. In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, furnish the following:
- B. Manufacturer's Literature and Data: Manufacturer's complete and detailed application instructions and specifications.
- C. Certificates:
 - 1. Certificates, accompanied by complete test report and test record from testing laboratories attesting that the proposed fireproofing material and application method meet the specified fire rating.
 - a. Certificate shall list thickness and density of material proposed for use, as required to meet the specified fire rating.
 - b. Letter from testing laboratories summarizing a test, but not containing the complete test results, will not

be accepted as meeting the requirements for submission of complete test reports and test records.

- c. Certificate indicating that the sprayed-on fireproofing material supplied under the Contract, is the same within manufacturing tolerance as the fireproofing material tested.

- D. Miscellaneous: Manufacturer's written approval of surfaces to receive sprayed-on fireproofing.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Fireproofing material shall be delivered to job-site in sealed containers marked and labeled to show manufacturer's name and brand and certification of compliance with the specified requirements. Damaged containers will be rejected and shall be removed from the site.
- B. Store the materials off the ground, under cover, away from damp surfaces. Keep dry until ready for use. Materials that have been exposed to water before installation shall be removed from the site.

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 test by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
 - SS-S-111B.....Sound Controlling Materials (Trowel And Spray Applications)
- C. American Society For Testing and Materials (ASTM):
 - E605.....Test for Thickness and Density of Fireproofing.
 - E759.....Test Method for Effect of Deflection of Sprayed Fire-Resistive Materials Applied to Structural Members.
 - E84-81.....Surface Burning Characteristics of Building Materials
 - E760.....Test Method for Effect of Impact on Binding of Sprayed Fire-Resistive Material Applied to Structural Members.
 - E859.....Test Method for Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members.
 - E937.....Test Method for Corrosion of Steel by Sprayed Fire-Resistive Materials Applied to Structural Members.
 - E119-83.....Fire Tests of Building Construction and Materials

- D. National Fire Prevention Association (NFPA)
NFPA 521.....Standard Methods of Fire Tests of Building
Construction and Materials
- E. Underwriters Laboratories, Inc. (UL):
UL 263.....Fire Tests of Building Construction and
Materials

PART 2 - PRODUCTS

2.1 SPRAYED-ON FIREPROOFING

- A. Manufacturers: The basis of design is Monokote MK-6HY and Retroguard by W.R. Grace Co. Subject to compliance with specified requirements, "or equal" products by the following manufacturers may also be acceptable:
1. Carboline Co., Fireproofing Div.
 2. Isolatek International Corp., Cafco Products.
- B. Fed. Spec. SS-S-111, Class 25, Type I, factory mixed cementitious materials with approved aggregate, and integral inorganic binders, having the following characteristics:
1. Material containing asbestos are not permitted.
 2. Minimum applied dry density per cubic foot:
 - a. Type I - 15 pounds
 3. Deflection: Material shall not crack or delaminate from the surface to which it is applied when tested in accordance with ASTM E759.
 4. Corrosion Resistance: Steel with applied replacement fireproofing shall be tested in accordance with ASTM E937 without evidence of corrosion of the steel.
 5. Bond-Impact Test: In accordance with ASTM E760, impact test. Test specimen shall not crack or delaminate the material from the surface to which it is applied.
 6. Bond Strength: Replacement fireproofing, when tested in accordance with ASTM E736, shall have a minimum average bond strength of 200 PSF, and a minimum individual bond strength of 200 psf, and a minimum individual bond strength of 150 psf.
 7. Air Erosion: Maximum allowable weight loss of the fireproofing material shall be 0.025 gm/f+2 when tested in accordance with ASTM E859.
 8. Surface Burning Characteristics: Surface Burning characteristics of fireproofing material when tested in accordance with ASTM E84 shall be as follows:

Flame spread.....0
Fuel contributed...5 or less
Smoke developed....0

2.2 ADHESIVE (Not Used).

2.3 SEALER (Not Used).

2.4 WATER

- A. Clean, fresh, and free from organic and mineral impurities.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Surface to receive fireproofing shall be clean and free of dust, soot, oil, grease water soluble materials or any foreign substance which would prevent adhesion of the fireproofing material.
- B. Coordinate application of fireproofing material with other trades. Install all hangers, inserts and clips before the application of fireproofing material. Install ductwork, piping and other obstructing material and equipment after the fireproofing is complete.
- C. Applicators shall be approved by the manufacturer of fireproofing material. No fireproofing material shall be applied prior to completion of concrete work on steel decking and concrete encased steel.
 - 1. Application shall not start until written approval has been obtained from Veterans Professional Industrial Hygienist (VPIH) that surfaces have been inspected by the VPIH, and are suitable to receive sprayed-on fireproofing.
 - 2. Mixing and application shall be in accordance with manufacturer's instruction. Furnish two copies of manufacturer's application instructions to the Project Engineer prior to commencement of work. Material and water ratios shall be mechanically controlled on the project site. Apply adhesive and sealer, when not in integral part of the materials, in accordance with the manufacturer's instructions.
 - 3. Temperature and enclosure conditions shall be as required by fireproofing material manufacturer.
 - 4. Application shall be completed in one area, inspected and approved by Project Engineer before removal of application equipment and proceeding with further work.
 - 5. Manufacturer's representative shall observe and advise at the commencement of application, and shall visit the site as required thereafter for the purpose of ascertaining proper application. The representative shall give manufacturer's approval of completed installation.

3.2 PRE-APPLICATION TEST AREA

- A. A test area consisting of a typical overhead fireproofing installation, but not less than 15 linear feet of beam, shall be installed in location selected by the Project Engineer, for approval by the representative of the fireproofing material manufacturer and by the Government. Fireproofing in other areas shall not proceed until installation of test area has been

completed and approved. Approved installation shall remain in place and open for observation as criteria for all work under contract.

3.3 PATCHING AND REPAIRING

- A. Corrective measures shall be taken as directed by the Project Engineer. Manufacturer's representative of fire protection material shall submit recommendations through the Contractor to the Project Engineer for corrections and approval.
- B. Patch fireproofing material which is removed or disturbed after acceptance. Material for patching must be sprayed by machine directly on point to be patched; or, into a container and then hand applied. Hand mixing of material is not permitted.
- C. Repair: Re-spray all test and rejected areas. Final inspection of sprayed areas shall be conducted. Inspect after mechanical, electrical and other trades have completed work in contact with fireproofing material, but before sprayed material is covered. Re-spray all areas requiring additional fireproofing material to provide the required thickness.

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SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Firestopping as described herein, consists of furnishing and installing materials, or combinations of materials, to form an effective barrier against the spread of flame and hot gases, and to maintain the integrity of time rated construction. It shall be used for fire or smoke barriers that require sealing around penetrations in accordance with NFPA-101 and NFPA 70 when applicable. Types of construction included are two hour partitions, one hour partitions, smoke partitions, floors and interstitial space walk-on decks, chase enclosures, and partitions above ceilings.

1.2 SUBMITTALS

- A. In accordance with Section 01340, SAMPLES AND SHOP DRAWINGS, furnish the following:
1. Manufacturers literature and installation instructions.
 2. Certificates: Indicating firestopping material conforms to specified requirements.
 3. Shop Drawings: Complete construction details showing proposed material, reinforcement, anchorage, fastenings, and method of installation.

1.3 DELIVERY AND STORAGE

- A. All materials shall be delivered in their original unopened containers and stored in a location providing protection from damage and exposure to the elements. Damaged or deteriorated materials shall be removed from the site.

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):
- C24-79.....Pyrometric Cone Equivalent (PCE) of
Refractory Materials
- E84-81.....Surface Burning Characteristics of
Building Materials
- E119-83.....Fire Tests of Building Construction and
Materials
- E814-81.....Fire Tests of Through-Penetration Fire
Stops

- C. National Fire Protection Association (NFPA):
- 70-78.....National Electrical Code
- 101-81.....Life Safety Code
- 258-76.....Standard Test Method for Measuring the
Smoke Generated by Solid Materials

2.1 MATERIALS

- A. Rock Wool Fiber: Minimum four pound per cubic foot density. Flame spread 25, smoke developed 0 when tested in accordance with ASTM E84. Minimum melt point shall be 2000 degrees F when tested in accordance with ASTM C24.
- B. Silicone Foam Sealant: Fire retardant, service temperature from minus 50 degrees F to plus 450 degrees F; nontoxic and nonallergenic; UL classified as passing ASTM E119 fire and hose stream tests, flame spread rating 20, fuel contributed factor 20 when tested in accordance with ASTM E84.
1. Form: Two-part liquid product pre-measured and contained in a hand operated disposable cartridge for mixing and dispensing.
 2. Characteristic after Dispensing: Fully expanded in five minutes, fully cured in 24 hours; approximate density 20 pounds per cubic foot.
- C. Intumescent Materials: Intumescent caulks, putty and sheets shall be capable of expanding up to 10 times when exposed to temperatures over 250 degrees F. One part no-mixing system that is non-corrosive and compatible with synthetic cable jackets; UL classified as passing ASTM E814 fire and hose stream tests, flame spread less than 20, fuel contribution 0 when tested in accordance with ASTM E84.
- D. Other Materials: Materials such as concrete, gypsum cement, masonry mortar or combinations of such materials may be used subject to meeting the specified requirements and Project Engineers approval.

2.2 PHYSICAL REQUIREMENTS

- A. Materials used for firestopping shall meet the following requirements:
1. Materials used to seal penetrations in time rated floor or wall assemblies shall be capable of preventing the passage of smoke, flame and hot gases sufficient to ignite cotton waste when subjected to time-temperature fire conditions on the opposite side of the wall when tested in accordance with ASTM E119 for the adjacent construction.
 2. Non-toxicity: Non-toxic to human beings at all stages of application and during fire conditions.
 3. Flame spread: 25 or less, ASTM E84.

4. Fuel contribution: 25 or less, ASTM E84.
5. Smoke density: 250 or less, NFPA 258.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor shall examine areas to receive firestopping prior to beginning work or submitting data required by paragraph, SUBMITTALS. Data to be submitted shall be based on the findings of the Contractor's examination.

3.2 LOCATIONS

- A. Duct, conduit, and piping penetrations through floor slab and through time rated partitions and/or fire walls and interstitial space walk on decks. Unless otherwise specified or shown on the drawings, the Contractor shall assume that all floor slabs will be considered as time rated, and all walls or partitions having, or which are part of an enclosure having, fire rated doors will be considered as time rated.
- B. Penetration of vertical service shafts.
- C. Other locations where specifically shown on the drawings, or where called for in other sections of the specification.

3.3 INSTALLATION

- A. Installation shall be in accordance with approved construction drawings (shop drawings), and approved manufacturer's literature and installation instructions.
- B. Except for intumescent type firestopping materials, the firestopping materials shall completely fill the void space regardless of geometric configuration. Floors and partitions that are sealed with masonry or concrete shall be carefully filled and inspected for cracks or other imperfection. Intumescent firestopping materials shall be installed in accordance with manufacturers' printed instructions.
- C. Pipe Insulation: Insulated pipes and ducts penetrating fire rated floors and walls shall be insulated with material which provides the same performance as the firestopping material. This material shall extend a minimum of six inches on each side of the opening. Vapor barrier of such insulation shall have a perm rating of 0.03 maximum.

3.4 CLEAN-UP AND ACCEPTANCE OF WORK

- A. As work on each floor is completed, remove materials, litter, and debris. All work shall be inspected and accepted by the Contracting Officer or his designated representative before materials and equipment is moved to the next-scheduled work area.

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SECTION 07 92 00

SEALANTS AND CAULKING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section covers sealant and caulking material and application.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS:
1. Manufacturer's installation instructions for each product used.
 2. Cured samples of exposed sealants for each color where required to match adjacent material.
 3. Manufacturer's Literature and Data for:
 - a. Caulking compound
 - b. Primers
 - c. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.3 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 or less than 40 degrees F.

1.4 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.

1.5 GUARANTEE

- A. Guarantee exterior sealing against leaks and subject to terms of "Guaranty" Article specified in Section, SPECIAL REQUIREMENTS,

except that guaranty period shall be two years in lieu of one year.

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):
 - C570-72(1985).....Oil and Resin-Base Caulking Compound for Building Construction.
 - C612-83.....Mineral Fiber Block and Board Thermal Insulation.
 - C717-88.....Definitions of Terms Relating to Building Seals and Sealants (Rev. A).
 - C790-84.....Use of Latex Sealing Compounds
 - C804-83.....Use of Solvent-Release Type of Sealants.
 - C834-76(1986).....Latex Sealing Compounds
 - C920-87.....Elastomeric Joint Sealants
 - C962-86.....Use of Elastomeric Joint Sealants
 - C1085-87.....Butyl Rubber-Based Solvent-Release Sealants.

PART 2 - PRODUCTS

2.1 SEALANTS

- A. Subject to compliance with specified requirements, sealants shall be the product of one of the following:
 - 1. Tremco Sealant/Weatherproofing division of RPM International, Inc.
 - 2. 3M Company.
 - 3. Pecora Corp.
 - 4. Dow Corning Corp.
 - 5. GE Corp.
- B. S-6
 - 1. ASTM C920, silicone, neutral cure.
 - 2. Type S.
 - 3. Class: Joint movement range of plus 100 percent to minus 50 percent.
 - 4. Grade NS.

- 5. Shore A hardness of 15-20.
- 6. Minimum elongation of 1200 percent.
- C. 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 FIRESTOP CAULKING

- A. Fire Stop Sealant: Single component, noncombustible fire stop sealant Biotherm "T" self leveling silicone by Bio, Pensil 100 by GE, CP25WB by 3M, or equal.
- B. Fire Stop Putty: One-part intumescent type FSP by Nelson, MPS/MPP by 3M, or equal.
- C. Cementitious Fire Stop Mortar: Novasit K-10 (55 lb. density) by Bio, 3M mortar by 3M, or equal. Cementitious mortar shall be non-shrinking, asbestos free type.

2.3 COLOR

- A. Color of sealants shall be clear or white, unless specified otherwise.
- B. Caulking shall be light gray or white, unless specified otherwise.

2.4 BOND BREAKERS

- A. Polyethylene tape or similar type and consistency recommended by the sealant manufacturer for the particular application.
- B. Back-up Rod: ASTM C962, Type A, joint-fillers; closed cell neoprene, butyl, polyurethane, vinyl, or polyethylene rod; diameter approximately 1-1/3 times the joint width.

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 type.

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 ASTM C962.
- 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.
- 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.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printer 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.

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 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 the 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 the sealants and caulking only when the ambient temperature is between 40 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 printer 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 comparability with each other and substrate. Use only compatible sealant.
- B. For application of sealants, follow requirements of ASTM C962 unless specified otherwise.
- C. Follow requirements of ASTM C790 for application of C-1 caulking.
- D. Follow requirements of ASTM C804 for application of C-2 and C-3 caulking.
- E. Follow requirements of ASTM C570 for application of C-4 caulking.

3.6 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.

3.7 LOCATIONS

- A. Use S-6 for vertical and inclined joints at:
 - 1. Interior joints and recesses formed where frames of louvers and vents and the like adjoin other materials.
 - 2. Where sealant is shown on drawings, except where sealing compounds for joints in horizontal surfaces and high temperature (over 400 degrees F) applications are specifically required.
- B. Use S-6 at Metal-to-metal joints where sealing is shown or specified.
- C. Use S-6 or S-9 in fire rated partitions or combination fire and smoke or sound rated partitions.
- D. Use S-9 in baths, toilets, and showers. Use at openings between walls and partitions where pipes or toilet and bath accessories or anchors penetrate partition including openings between adjacent lockers, vanities, casework shelving, and plumbing fixtures, built-in or surface mounted.
- E. Use S-9 for sealing between adjoining wall finish and sinks, bath tubs, shower receptors, service sinks and penetrations of wall surfaces in showers including escutcheon (cover) plates.
- F. Use caulking compound or sealant for the following interior applications:
 - 1. Use C-1, C-2, C-3 or C-4 unless specified otherwise for:
 - a. Openings 1/4-inch and less between walls and partitions and adjacent lockers, casework, laboratory furniture, shelving, built-in or surface mounted equipment, and lighting fixtures.
 - b. Where caulking is shown on drawings.
 - c. Other interior locations where small voids between materials require filling for painting.

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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. Section 05 50 00, METAL FABRICATIONS.
- B. Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- C. Section 08 17 00, MANUAL PUSH UP COILING COUNTERS.
- D. Door Hardware: Section 08 71 00, DOOR HARDWARE.

1.3 TESTING

An independent testing laboratory shall perform testing.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers Literature and Data: Fire rated doors and frames, showing conformance with NFPA 80 and Underwriters Laboratory, Inc., or Intertek Testing Services or Factory Mutual fire rating requirements.

1.5 SHIPMENT

- A. Prior to shipment label each door and frame to show location, size, door swing and other pertinent information.
- B. Fasten temporary steel spreaders across the bottom of each door frame.

1.6 STORAGE AND HANDLING

- A. Store doors and frames at the site under cover.
- B. Protect from rust and damage during storage and erection until completion.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
 - L-S-125B..... Screening, Insect, Nonmetallic
- C. Door and Hardware Institute (DHI):
 - A115 Series..... Steel Door and Frame Preparation for Hardware, Series A115.1 through A115.17 (Dates Vary)
- D. Steel Door Institute (SDI):
 - 113-01..... Thermal Transmittance of Steel Door and Frame Assemblies
 - 128-1997..... Acoustical Performance for Steel Door and Frame Assemblies
 - A250.8-03..... Standard Steel Doors and Frames
- E. American Society for Testing and Materials (ASTM):
 - A167-99(R2004)..... Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - A568/568-M-07..... Steel, Sheet, Carbon, and High-Strength, Low-alloy, Hot-Rolled and Cold-Rolled
 - A1008-08..... Steel, sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability
 - B209/209M-07..... Aluminum and Aluminum-Alloy Sheet and Plate
 - B221/221M-08..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
 - D1621-04..... Compressive Properties of Rigid Cellular Plastics
 - D3656-07..... Insect Screening and Louver Cloth Woven from Vinyl Coated Glass Yarns
 - E90-04..... Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
- F. The National Association Architectural Metal Manufacturers (NAAMM):
 - Metal Finishes Manual (1988 Edition)

- G. National Fire Protection Association (NFPA):
80-09..... Fire Doors and Fire Windows
- H. Underwriters Laboratories, Inc. (UL):
Fire Resistance Directory
- I. Intertek Testing Services (ITS):
Certifications Listings...Latest Edition
- J. Factory Mutual System (FM):
Approval Guide

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A167, Type 302 or 304; finish, NAAMM Number 4.
- B. Sheet Steel: ASTM A1008, cold-rolled for panels (face sheets) of doors.
- C. Anchors, Fastenings and Accessories: Fastenings anchors, clips connecting members and sleeves from zinc coated steel.
- D. Aluminum Sheet: ASTM B209/209M.
- E. Aluminum, Extruded: ASTM B221/221M.
- F. Prime Paint: Paint that meets or exceeds the requirements of A250.8.

2.2 FABRICATION GENERAL

- A. GENERAL:
 - 1. Follow SDI 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 SDI A250.8. Thickness, 44 mm (1-3/4 inches), unless otherwise shown.
 - 2. Close top edge of exterior doors flush and seal to prevent water intrusion.
 - 3. When vertical steel stiffeners are used for core construction, fill spaces between stiffeners with mineral fiber insulation.
- B. Standard Duty Doors: SDI A250.8, Level 1, Model 2 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: SDI A250.8, Level 2, Model 2 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. Smoke Doors:

1. Close top and vertical edges flush.
2. Provide seamless vertical edges.
3. Apply Steel astragal to the meeting stile at the active leaf of pair of doors or double egress doors.
4. Provide clearance at head, jamb and sill as specified in NFPA 80.

E. Fire Rated Doors (Labeled):

1. Conform to NFPA 80 when tested by Underwriters Laboratories, Inc., Inchcape Testing Services, or Factory Mutual for the class of door or door opening shown.
2. Fire rated labels of metal, with raised or incised markings of approving laboratory shall be permanently attached to doors.
3. Close top and vertical edges of doors flush. Vertical edges shall be seamless. Apply steel astragal to the meeting stile of the active leaf of pairs of fire rated doors, except where vertical rod exit devices are specified for both leaves swinging in the same direction.
4. Construct fire rated doors in stairwell enclosures for maximum transmitted temperature rise of 230 °C (450 °F) above ambient temperature at end of 30 minutes of fire exposure when tested in accordance with ASTM E152.

2.3 METAL FRAMES

A. General:

1. SDI A250.8, 1.3 mm (0.053 inch) thick sheet steel, types and styles as shown or scheduled.
2. Frames for exterior doors: Fabricate from 1.7 mm (0.067 inch) thick galvanized steel conforming to ASTM A525.
3. Frames for labeled fire rated doors and windows where they occur.
 - a. Comply with NFPA 80. Test by Underwriters Laboratories, Inc., Inchcape Testing Services, or Factory Mutual.
 - b. Fire rated labels of approving laboratory permanently attached to frames as evidence of conformance with

these requirements. Provide labels of metal or engraved stamp, with raised or incised markings.

4. Knocked-down frames are not acceptable.

B. Reinforcement and Covers:

1. SDI A250.8 for, minimum thickness of steel reinforcement welded to back of frames.
2. Provide mortar guards securely fastened to back of hardware reinforcements except on lead-lined frames.
3. Where concealed door closers are installed within the head of the door frames, prepare frames for closers and provide 1 mm (0.042 inch) thick steel removable stop sections for access to concealed face plates and control valves, except when cover plates are furnished with closer.

C. Terminated Stops: SDI A250.8.

D. Glazed Openings and Panel Opening:

- a. Integral stop on exterior, corridor, or secure side of door.
- b. Design rabbet width and depth to receive glazing material or panel shown or specified.

E. Frame Anchors:

1. Floor anchors:

- a. Where floor fills occur, provide extension type floor anchors to compensate for depth of fill.
- b. At bottom of jamb use 1.3 mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive two 6 mm (1/4 inch) floor bolts. Use 50 mm x 50 mm (2 inch by 2 inch) 9 mm by (3/8 inch) clip angle for lead lined frames, drilled for 9 mm (3/8 inch) floor bolts.
- c. Where mullions occur, provide 2.3 mm (0.093 inch) thick steel channel anchors, drilled for two 6 mm (1/4 inch) floor bolts and frame anchor screws.
- d. Where sill sections occur, provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for 6 mm (1/4 inch) floor bolts and frame anchor screws. Space floor bolts at 50 mm (24 inches) on center.

2. Jamb anchors:

- a. Locate anchors on jambs near top and bottom of each frame, and at intermediate points not over 600 mm (24

inches) apart, except for fire rated frames space anchors as required by labeling authority.

- b. Form jamb anchors of not less than 1 mm (0.042 inch) thick steel unless otherwise specified.
- c. Anchors set in masonry: Use adjustable anchors designed for friction fit against the frame and for extension into the masonry not less than 250 mm (10 inches). Use one of following type:
 - 1) Wire loop type of 5 mm (3/16 inch) diameter wire.
 - 2) T-shape or strap and stirrup type of corrugated or perforated sheet steel.
- d. Anchors for stud partitions: Either weld to frame or use lock-in snap-in type. Provide tabs for securing anchor to the sides of the studs.
- e. Anchors for frames set in prepared openings:
 - 1) Steel pipe spacers with 6 mm (1/4 inch) inside diameter welded to plate reinforcing at jamb stops or hat shaped formed strap spacers, 50 mm (2 inches) wide, welded to jamb near stop.
 - 2) Drill jamb stop and strap spacers for 6 mm (1/4 inch) flat head bolts to pass thru frame and spacers.
- f. Anchors for observation windows and other continuous frames set in stud partitions.
 - 1) In addition to jamb anchors, weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.
 - 2) Anchors spaced 600 mm (24 inches) on centers maximum.
- g. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

2.4 TRANSOM PANELS

- A. Fabricate panels as specified for flush doors.
- B. Fabricate bottom edge with rabbet stop to fit top of door where no transom bar occurs.

2.5 LOUVERS

- A. General:

1. Sight proof type with stationary blades the full thickness of the door.
2. Design lightproof louvers to exclude passage of light but permit free ventilation.
3. Provide insect screen and wire guards at exterior doors, except where doors are located below completely enclosed areaways, the wire guard is not required.

B. Fabrication:

1. Steel louvers 0.8 mm (0.032 inch) thick for interior doors, and 1.3 mm (0.053 inch) inch thick for exterior doors.
2. Fabricate louvers as complete units. Install in prepared cutouts in doors.
3. Weld stationary blades to frames. Weld louvers into door openings.

C. Screen frames:

1. Frame of either extruded aluminum or tubular aluminum.
2. Fabricate frame to hold wire fabric in a channel with a retaining bar anchor and to mount on surface of door with screws.
3. Do not lap frame over louver opening.
4. Miter corners of frame members and join by concealed mechanical fastenings extending about 57 mm (2-1/4 inches) into ends of each member.
5. Drill frame and doors for screw attachment. Space screws 50 mm (2 inches) from end of each leg of frame and not over 300 mm (12 inches) on center between end screws.
6. Finish: Clear anodized finish, 0.4 mils thick.
7. Insect Screens: Fasten insect screens to interior side of doors with retaining bar against door and not exposed to view.
8. Wire Guards:
 - a. Wire fabric shall be wire guard screen as specified.
 - b. Fasten wire guard to exterior side of door with retaining bar against door and not exposed to view.

2.6 SHOP PAINTING

SDI A250.8.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Plumb, align and brace frames securely until permanent anchors are set.
 - 1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
 - 2. Use wood spreaders at bottom of frame if the shipping spreader is removed.
 - 3. Protect frame from accidental abuse.
 - 4. Where construction will permit concealment, leave the shipping spreaders in place after installation, otherwise remove the spreaders after the frames are set and anchored.
 - 5. Remove wood spreaders and braces only after the walls are built and jamb anchors are secured.
- B. Floor Anchors:
 - 1. Anchor the bottom of door frames to floor with two 6 mm (1/4 inch) diameter expansion bolts. Use 9 mm (3/8 inch) bolts on lead lined frames.
 - 2. Power actuated drive pins may be used to secure frame anchors to concrete floors.
- C. Jamb Anchors:
 - 1. Anchors in masonry walls: Embed anchors in mortar. Fill space between frame and masonry wall with grout or mortar as walls are built.
 - 2. Coat frame back with a bituminous coating prior to lining of grout filling in masonry walls.
 - 3. Secure anchors to sides of studs with two fasteners through anchor tabs. Use steel drill screws to steel studs.
 - 4. Frames set in prepared openings of masonry or concrete: Expansion bolt to wall with 6 mm (1/4 inch) expansion bolts through spacers. Where subframes or rough bucks are used, 6 mm (1/4 inch) expansion bolts on 600 mm (24 inch) centers or power activated drive pins 600 mm (24 inches) on centers. Secure two piece frames to subframe or rough buck with machine screws on both faces.
- D. Install anchors for labeled fire rated doors to provide rating as required.
- E. Frames for Sound Rated Doors: Coordinate to line frames for sound rated doors with insulation.

- F. Overhead Bracing (Lead Lined Frames): Where jamb extensions extend to structure above, anchor clip angles with not less than two, 9 mm (3/8 inch) expansion bolts or power actuated drive pins to concrete slab. Weld to steel overhead members.

3.2 INSTALLATION OF DOORS AND APPLICATION OF HARDWARE

Install doors and hardware as specified in Sections Section 08 11 13, HOLLOW METAL DOORS AND FRAMES 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 prefinish, prefit option.

1.2 RELATED WORK

- A. Metal door frames: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.
- B. Door hardware including hardware location (height): Section 08 71 00, DOOR HARDWARE.
- C. 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.
- D. Finish: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: Veneer sample 200 mm (8 inch) by 275 mm (11 inch) by 6 mm (1/4 inch) showing specified wood species sanded to receive a transparent finish. Factory finish veneer sample where the prefinished option is accepted.
- C. Shop Drawings:
 - 1. Show every door in project and schedule location in building.
 - 2. Indicate type, grade, finish and size; include pertinent details.
 - 3. Provide information concerning specific requirements not included in the manufacturer's literature and data submittal.
- D. 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 30 years.

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, J-1 Job Site Information.
- C. Label package for door opening where used.

1.6 APPLICABLE PUBLICATIONS

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.1-A-04.....Architectural Wood Flush Doors

I.S.4-07A.....Water-Repellent Preservative Non-Pressure
Treatment for Millwork

I.S.6A-01.....Architectural Wood Stile and Rail Doors

T.M.5-90.....Split Resistance Test Method

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.....Screwholding Test Method

- C. National Fire Protection Association (NFPA):

80-07.....Protection of Buildings from Exterior Fire

252-08.....Fire Tests of Door Assemblies

- D. ASTM International (ASTM):

E90-04.....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: 45 mm (1-3/4 inches) unless otherwise shown or specified.

B. Face Veneer:

1. In accordance with WDMA I.S.1-A.
2. One species throughout the project unless scheduled or otherwise shown.
3. For transparent finishes: Premium Grade. rotary cut, white maple, white Birch' red oak, or white oak as selected by the Architect.
 - a. A grade face veneer standard optional.
 - b. AA grade face veneer
 - c. Match face veneers for doors for uniform effect of color and grain at joints.
 - d. Door edges shall be same species as door face veneer except maple may be used for stile face veneer on birch doors.
 - e. In existing buildings, where doors are required to have transparent finish, use wood species and grade of face veneers to match adjacent existing doors.
4. For painted finishes: Custom Grade, mill option close grained hardwood, premium or medium density overlay. Do not use Lauan.
5. Factory sand doors for finishing.

C. Wood for stops, louvers, muntins and moldings of flush doors required to have transparent finish:

1. Solid Wood of same species as face veneer, except maple may be used on birch doors.
2. Glazing:
 - a. 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 125 mm (5 inches) on centers.

- b. Use stainless steel or dull chrome plated brass screws for exterior doors.
 - 3. Wood Louvers:
 - a. Door manufacturer's standard product, fabricated of solid wood sections.
 - b. Wood Slats: Not less than 5 mm (3/16 inch) thick.
 - c. Stiles routed out to receive slats.
 - d. Secure louvers in prepared cutouts with wood stops.
- D. Stiles and Rails:
 - 1. Option for wood stiles and rails:
 - a. 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.
- E. Fire rated wood doors:
 - 1. Fire Performance Rating:
 - a. "B" label, 1-1/2 hours.
 - b. "C" label, 3/4 hour.
 - 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 #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 125 mm (five 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.
- F. 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.

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.
- C. Flush doors to receive transparent finish (in addition to being prefit) shall be factory finished as follows:
 - 1. WDMA I.S.1-A Section F-3 specification for System TR-4, Conversion Varnish or System TR-5, Catalyzed Vinyl.
 - 2. Use stain when required to produce the finish specified in Section 09 06 00 SCHEDULE FOR FINISHES.

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 veneer and quality certification.
 - 4. Identification of preservative treatment for stile and rail doors.

2.4 SEALING:

Give top and bottom edge of doors two 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 3 mm (1/8 inch) clearance at the jambs, heads, and meeting stiles, and a 19 mm (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 mechanical seal: 10 mm (3/8 inch).
- C. Provide cutouts for special details required and specified.
- D. Rout 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 3 mm (1/8 inch) for each 50 mm (two inches) of door thickness. Undercut where shown or required.
- 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

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 Project Engineer.

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SECTION 08 31 05

ACCESS DOORS

PART 1 - GENERAL

1.1 DESCRIPTION

This section covers access doors.

1.2 SUBMITTALS

In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, furnish the following:

A. Shop Drawings:

Access doors, each type, showing construction, location and installation details.

B. Manufacturer's Literature and Data:

Access doors, each type

1.3 APPLICABLE PUBLICATIONS

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

A. The National Association of Architectural Metal Manufacturers (NAAMM):

Metal Finishes Manual (AMP 500-06)

PART 2 - PRODUCTS

2.1 FABRICATION, GENERAL

A. Fabricate components so as to be straight, square, flat and in same plane where required. Slightly round exposed edges and provide access without burrs, snags and sharp edges. Welds where exposed shall be continuous and ground smooth.

B. Number of locks and non-continuous hinges shall be as required to maintain alignment of panel with frame.

C. Provide anchors or make provisions in frame for anchoring to adjacent construction. Provide size, number and location of anchors as required to secure access door in opening.

2.2 ACCESS DOORS, FLUSH PANEL

A. Door Panel: Form of 0.0747 inch thick steel sheet. Reinforce as required to maintain flat surface.

B. Frame: Form of 0.0598 inch thick steel sheet of depth and configuration to suit material and type of construction where installed. Weld exposed joints in flange and grind smooth.

- C. Hinge: Concealed spring hinge to allow panel to open 175 degrees. Provide removable hinge pin to allow removal of panel from frame.
- D. Lock: Flush, screwdriver operated cam lock.

2.3 FINISH

- A. Steel Surfaces: shall have over the prime coat, a finish coat of baked-on enamel in color and texture to match the finish of the adjacent surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

3.2 ANCHORAGE

Secure frames to adjacent construction using anchors attached to the frames or by use of bolts or screws through the frame members. Type, size and number of anchoring device shall be suitable for the material surrounding the opening, and as required to maintain alignment and resist displacement during normal use of the access door and the building.

3.3 ADJUSTMENT

Adjust hardware so that the door panel will open freely, and when closed the door panel will be centered within 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 11 13, HOLLOW METAL DOORS AND FRAMES, and Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- C. Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.
- D. Painting: Section 09 91 00, PAINTING.
- E. Electrical: Division 26, ELECTRICAL.

1.3 GENERAL

- A. All hardware shall comply with UFAS, (Uniform Federal Accessible Standards) unless specified otherwise.
- B. Provide rated door hardware assemblies where required by most current version of the International Building Code (IBC).
- C. Hardware for Labeled Fire Doors and Exit Doors: Conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Provide hardware listed by UL, except where heavier materials, large size, or better grades are specified herein under paragraph HARDWARE SETS. In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements.
- D. Hardware for application on metal and wood doors and frames shall be made to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.
- E. The following items shall be of the same manufacturer, if possible, 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 52.24-21, except that the Warranty period shall be two years in lieu of one 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.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23 plus 2 copies to the VAMC Locksmith (VISN Locksmith if the VAMC does not have a locksmith).
- B. Hardware Schedule: Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (if fire rated and listed)	ANSI/BHMA Finish Designation

- C. Samples and Manufacturers' Literature:
 1. Samples: All hardware items (proposed for the project) that have not been previously approved by Builders Hardware Manufacturers Association shall be submitted for approval. Tag and mark all items with manufacturer's name, catalog number and project number.
 2. Samples are not required for hardware listed in the specifications by manufacturer's catalog number, if the contractor proposes to use the manufacturer's product specified.
- D. Certificate of Compliance and Test Reports: Submit certificates that hardware conforms to the requirements specified herein.

Certificates shall be accompanied by copies of reports as referenced. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an independent laboratory, within four years of submittal of reports for approval.

1.7 DELIVERY AND MARKING

- A. Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to Project Engineer for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in Project Engineer's office until all other similar items have been installed in project, at which time the Project Engineer 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. Manufacturers' Catalog Number References: Where manufacturers' products are specified herein, products of other manufacturers which are considered equivalent to those specified may be used. Manufacturers whose products are specified are identified by abbreviations as follows:

Adams-Rite	Adams Rite Mfg. Co.	Pomona, CA
Best	Best Access Systems	Indianapolis, IN
Don-Jo	Don-Jo Manufacturing	Sterling, MA

G.E. Security	GE Security, Inc.	Bradentown, FL
Markar	Markar Architectural Products	Pomona, CA
Pemko	Pemko Manufacturing Co.	Ventura, CA
Rixson	Rixson	Franklin Park, IL
Rockwood	Rockwood Manufacturing Co.	Rockwood, PA
Securitron	Securitron Magnalock Corp.	Sparks, NV
Southern Folger	Southern Folger Detention Equipment Co.	San Antonio, TX
Stanley	The Stanley Works	New Britain, CT
Tice	Tice Industries	Portland, OR
Trimco	Triangle Brass Mfg. Co.	Los Angeles, CA
Zero	Zero Weather Stripping Co.	New York, NY

C. Keying: All cylinders shall be keyed into existing 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 6 pin type. Keying information shall be furnished at a later date by the Project Engineer.

1. Keying information will be furnished to the Contractor by the Project Engineer.
2. Supply information regarding key control of cylinder locks to manufacturers of equipment having cylinder type locks. Notify Project Engineer immediately when and to whom keys or keying information is supplied. Return all such keys to the Project Engineer.

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 three-knuckle hinges, except five-knuckle where the required hinge type is not available in a three-knuckle version (e.g., some types of swing-clear hinges). The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified:

1. Exterior Doors: Type A2112/A5112 for doors 900 mm (3 feet) wide or less and Type A2111/A5111 for doors over 900 mm (3 feet) wide. Hinges for exterior outswing doors shall have non-removable pins. Hinges for exterior fire-rated doors shall be of stainless steel material.
2. Interior Doors: Type A8112/A5112 for doors 900 mm (3 feet) wide or less and Type A8111/A5111 for doors over 900 mm (3 feet) wide. Hinges for doors exposed to high humidity areas (shower rooms, toilet rooms, kitchens, janitor rooms, etc. shall be of stainless steel material.

B. Provide quantity and size of hinges per door leaf as follows:

1. Doors up to 1210 mm (4 feet) high: 2 hinges.
2. Doors 1210 mm (4 feet) to 2260 mm (7 feet 5 inches) high: 3 hinges minimum.
3. Doors greater than 2260 mm (7 feet 5 inches) high: 4 hinges.
4. Doors up to 900 mm (3 feet) wide, standard weight: 114 mm x 114 mm (4-1/2 inches x 4-1/2 inches) hinges.
5. Doors over 900 mm (3 feet) to 1065 mm (3 feet 6 inches) wide, standard weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
6. Doors over 1065 mm (3 feet 6 inches) to 1210 mm (4 feet), heavy weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
7. Provide heavy-weight hinges where specified.
8. At doors weighing 330 kg (150 lbs.) or more, furnish 127 mm (5 inch) high hinges.

C. See Articles "MISCELLANEOUS HARDWARE" and "HARDWARE SETS" for pivots and hinges other than butts specified above and continuous hinges specified below.

2.2 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- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); 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 6.35mm (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: Stainless steel or Aluminum.
 - 3. Base Metal for Hinges for Fire-Rated Assemblies: Stainless steel or 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. Provide with manufacturer's cut-outs for separate mortised power transfers and/or mortised automatic door bottoms where they occur.
 - 7. Where thru-wire power transfers are integral to the hinge, provide hinge with easily removable portion to allow easy access to wiring connections.
 - 8. 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 for each type specified.

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 1 ½" (38mm) 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 breakout. 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 COMBINATION CLOSER - HOLDER

- A. Conform to ANSI A156.15; combination closer-holder with built-in electronic release.
- B. Combination closer-holder shall have the following features:
 - 1. Control door closing and latching sequence by hydraulic action.
 - 2. Wiring for 24V DC current. Current draw shall not exceed 0.16 amperes.
 - 3. Combination closer-holder type:

- a. At doors with 90-110° hold-open point: Single lever arm with slide track closing action, and adjustable hydraulic back-check. Provide tracks with spring-cushion stop assemblies to avoid the necessity of a separate wall or floor stop. Provide with double egress arm where required.
 - b. At doors with over 110° to 175° hold-open point: Single or double lever arm and adjustable hydraulic back-check. Provide with long arms where required for deep frame reveals.
- 4. Spring power for closing force shall conform to ANSI A156.4 and have 50% spring power adjustment.
 - 5. Size closers per manufacturer's printed catalog recommendations.
 - 6. Hold open mechanism shall hold door open between 85 degrees and 175 degrees depending on wall and frame conditions. Mount device to provide maximum door opening permitted by building construction or equipment.
 - 7. Electronic release shall release door when signaled by smoke detector. Smoke detectors shall not be incorporated as an integral part of door holders. Smoke detectors are specified in the ELECTRICAL Section.
 - 8. All closers to have full covers.
 - 9. All closers shall have a 1 ½" minimum piston diameter and an adjustable back check position valve.

2.7 DOOR STOPS

- A. Conform to ANSI A156.16.
- B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use lead expansion shields for mounting door stops.
- C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.
- D. Provide floor stops (Type L02141 or L02161 in office areas; Type L02121 x 3 screws into floor elsewhere. Wall bumpers, where used, must be installed to impact the trim or the door within the leading half of its width. Floor stops, where used, must be installed within 4-inches of the wall face and impact the door within the leading half of its width.
- E. Where drywall partitions occur, use floor stops, Type L02141 or L02161 in office areas, Type L02121 elsewhere.

- F. Provide stop Type L02011, as applicable for exterior doors. At outswing doors where stop can be installed in concrete, provide stop mated to concrete anchor set in 76mm (3-inch) core-drilled hole and filled with quick-setting cement.
- G. Omit stops where floor mounted door holders are required and where automatic operated doors occur.
- H. Provide appropriate roller bumper for each set of doors (except where closet doors occur) where two doors would interfere with each other in swinging.
- I. Provide appropriate door mounted stop on doors in individual toilets where floor or wall mounted stops cannot be used.
- J. Provide overhead surface applied stop Type C02541, ANSI A156.8 on patient toilet doors in bedrooms where toilet door could come in contact with the bedroom door.
- K. Provide door stops on doors where combination closer magnetic holders are specified, except where wall stops cannot be used or where floor stops cannot be installed within 4-inches of the wall.
- L. Where the specified wall or floor stop cannot be used, provide concealed overhead stops (surface-mounted where concealed cannot be used).

2.8 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.

2.9 FLOOR DOOR HOLDERS

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

2.10 LOCKS AND LATCHES

- A. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over shall have beveled fronts. Lock cylinders shall have not less than six pins. Cylinders for all locksets shall be removable core type. Cylinder shall be removable by special key or tool. Construct all cores so that they will be interchangeable into the core housings of all mortise locks, rim locks, cylindrical locks, and any other type lock included in the Great Grand Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. All locksets or latches on double doors with fire label shall have latch bolt with 19 mm (3/4 inch) throw, unless shorter throw allowed by the door manufacturer's fire label. Provide temporary keying device

or construction core of allow opening and closing during construction and prior to the installation of final cores.

- B. In addition to above requirements, locks and latches shall comply with following requirements:
1. Mortise Lock and Latch Sets: Conform to ANSI/BHMA A156.13. Mortise locksets shall be series 1000, minimum Grade 2. All locksets and latchsets, except on designated doors in Psychiatric (Mental Health) areas, shall have lever handles fabricated from cast stainless steel. No substitute lever material shall be accepted. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Lock function F02 shall be furnished with emergency tools/keys for emergency entrance. All lock cases installed on lead lined doors shall be lead lined before applying final hardware finish. Furnish armored fronts for all mortise locks. Where mortise locks are installed in high-humidity locations or where exposed to the exterior on both sides of the opening, provide non-ferrous mortise lock case.
 2. Cylindrical Lock and Latch Sets: levers shall meet ADA (Americans with Disabilities Act) requirements. Cylindrical locksets shall be series 4000 Grade I. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Provide lever design to match design selected by Architect or to match existing lever design. Where two turn pieces are specified for lock F76, turn piece on inside knob shall lock and unlock inside knob, and turn piece on outside knob shall unlock outside knob when inside knob is in the locked position. (This function is intended to allow emergency entry into these rooms without an emergency key or any special tool.)
 3. Auxiliary locks shall be as specified under hardware sets and conform to ANSI A156.5.
 4. Locks on designated doors in Psychiatric (Mental Health) areas shall be paddle type with arrow projection covers and be UL Listed. Provide these locks with paddle in the down position on both sides of the door. Locks shall be fabricated of wrought stainless steel.
 5. Privacy locks in non-mental-health patient rooms shall have an inside thumbturn for privacy and an outside thumbturn for emergency entrance. Single occupancy patient privacy doors shall typically swing out; where such doors cannot swing out, provide center-pivoted doors with rescue hardware (see HW-2B).

2.11 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.

2.12 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: 1500 lbf (6672 N).
 - 3. Inductive Kickback Peak Voltage: Not more than 53.
 - 4. Residual Magnetism: Not more than 4 lbf (18 N) to separate door from magnet.
- B. Delayed-Egress Locks: BHMA A156.24.
 - 1. Means of Egress Doors: Lock releases within 15 seconds after applying a force not more than 15 lbf (67 N) 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 (101mm) from the underside of the frame head stop.

2.13 ELECTRIC STRIKES

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

2.14 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

- B. Psychiatric keys shall be cut so that first two bittings closest to the key shoulder are shallow to provide greater strength at point of greatest torque.

2.15 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:
- Kick plates, mop plates and armor plates of metal, Type J100 series.
 - Provide kick plates and mop plates where specified. Kick plates shall be 254 mm (10 inches) or 305 mm (12 inches) high. Mop plates shall be 152 mm (6 inches) high. Both kick and mop plates shall be minimum 1.27 mm (0.050 inches) thick. Provide kick and mop plates beveled on all 4 edges (B4E). On push side of doors where jamb stop extends to floor, make kick plates 38 mm (1-1/2 inches) less than width of door, except pairs of metal doors which shall have plates 25 mm (1 inch) less than width of each door. Extend all other kick and mop plates to within 6 mm (1/4 inch) of each edge of doors. Kick and mop plates shall butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.
 - Kick plates and/or mop plates are not required on following door sides:
 - Armor plate side of doors;
 - Exterior side of exterior doors;
 - Closet side of closet doors;
 - Both sides of aluminum entrance doors.
 - Armor plates for doors are listed under Article "Hardware Sets". Armor plates shall be thickness as noted in the hardware set, 875 mm (35 inches) high and 38 mm (1-1/2 inches) less than width of doors, except on pairs of metal doors. Provide armor plates beveled on all 4 edges (B4E). Plates on pairs of metal doors shall be 25 mm (1 inch) less than width of each door. Where top of intermediate rail of door is less than 875 mm (35 inches) from door bottom, extend armor plates to within 13 mm (1/2 inch) of top of intermediate rail. On doors equipped with panic devices,

extend armor plates to within 13 mm (1/2 inch) of panic bolt push bar.

5. Where louver or grille occurs in lower portion of doors, substitute stretcher plate and kick plate in place of armor plate. Size of stretcher plate and kick plate shall be 254 mm (10 inches) high.
6. Provide stainless steel edge guards where so specified at wood doors. Provide mortised type instead of surface type except where door construction and/or ratings will not allow. Provide edge guards of bevel and thickness to match wood door. Provide edge guards with factory cut-outs for door hardware that must be installed through or extend through the edge guard. Provide full-height edge guards except where door rating does not allow; in such cases, provide edge guards to height of bottom of typical lockset armor front. Forward edge guards to wood door manufacturer for factory installation on doors.

2.16 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 25 mm by 63 mm (1 inch by 2-1/2 inches).
- D. Friction-fit cylindrical dustproof strikes with circular face plate may be used only where metal thresholds occur.
- E. Provide extension rods for top bolt where door height exceeds 2184 mm (7 feet 2 inches).

2.18 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 38 mm by 90 mm (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

- A. Conform to ANSI A156.6. Pull plate 90 mm by 350 mm (3-1/2 inches by 14 inches), unless otherwise specified. Cut plates of door pulls for cylinders, or turn pieces where required.

2.20 PUSH PLATES

- A. Conform to ANSI A156.6. Metal, Type J302, 200 mm (8 inches) wide by 350 mm (14 inches) high. Provide metal Type J300 plates 100 mm (4 inches wide by 350 mm (14 inches) high) where push plates are specified for doors with stiles less than 200 mm (8 inches) wide. Cut plates for cylinders, and turn pieces where required.

2.21 COMBINATION PUSH AND PULL PLATES

- A. Conform to ANSI 156.6. Type J303, stainless steel 3 mm (1/8 inch) thick, 80 mm (3-1/3 inches) wide by 800 mm (16 inches) high), top and bottom edges shall be rounded. Secure plates to wood doors with 38 mm (1-1/2 inch) long No. 12 wood screws. Cut plates for turn pieces, and cylinders where required. Pull shall be mounted down.

2.22 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 elevators entrances see other sections of specifications.
- C. At exterior doors and any interior doors exposed to moisture, provide threshold with non-slip abrasive finish.
- D. Provide with miter returns where threshold extends more than 12 mm (0.5 inch) from frame face.

2.24 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 (0.000774m³/s/m).

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. Wicket door (in roll-up door assemblies).
 3. Slide-up doors.
 4. Swing-up doors.
 5. Fire-rated access doors-Engineer's key set.
 6. Doors from corridor to electromagnetic shielded room.
 7. Day gate on vault door.
- C. Mutes: Conform to ANSI A156.16. Provide door mutes or door silencers Type L03011 or L03021, depending on frame material, of white or light gray color, on each steel or wood door frame, except at fire-rated frames, lead-lined frames and frames for sound-resistant, lightproof and electromagnetically shielded doors. Furnish 3 mutes for single doors and 2 mutes for each pair of doors, except double-acting doors. Provide 4 mutes or silencers for frames for each Dutch type door. Provide 2 mutes for each edge of sliding door which would contact door frame.

2.27 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.

2.28 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 Project Engineer for approval.
- B. Hardware Heights from Finished Floor:
1. Exit devices centerline of strike (where applicable) 1024 mm (40-5/16 inches).
 2. Locksets and latch sets centerline of strike 1024 mm (40-5/16 inches).
 3. Deadlocks centerline of strike 1219 mm (48 inches).
 4. Hospital arm pull 1168 mm (46 inches) to centerline of bottom supporting bracket.
 5. Centerline of door pulls to be 1016 mm (40 inches).
 6. Push plates and push-pull shall be 1270 mm (50 inches) to top of plate.
 7. Push-pull latch to be 1024 mm (40-5/16 inches) to centerline of strike.
 8. Locate other hardware at standard commercial heights. Locate push and pull plates to prevent conflict with other hardware.

3.2 INSTALLATION

- A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted on side of door inside rooms, inside stairs, and away from corridors 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
45 mm (1-3/4 inch)	900 mm (3 feet) and less	113 mm (4-1/2 inches)
45 mm (1-3/4 inch)	Over 900 mm (3 feet) but not more than 1200 mm (4 feet)	125 mm (5 inches)
35 mm (1-3/8 inch) (hollow core wood doors)	Not over 1200 mm (4 feet)	113 mm (4-1/2 inches)

- C. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim and surrounding conditions.
- D. Where new hinges are specified for new doors in existing frames or existing doors in new frames, sizes of new hinges shall match sizes of existing hinges; or, contractor may reuse existing hinges provided hinges are restored to satisfactory operating condition as approved by Project Engineer. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.

- E. Hinges Required Per Door:

Doors 1500 mm (5 ft) or less in height	2 butts
Doors over 1500 mm (5 ft) high and not over 2280 mm (7 ft 6 in) high	3 butts
Doors over 2280 mm (7 feet 6 inches) high	4 butts
Dutch type doors	4 butts
Doors with spring hinges 1370 mm (4 feet 6 inches) high or less	2 butts
Doors with spring hinges over 1370 mm (4 feet 6 inches)	3 butts

- F. Fastenings: Suitable size and type and shall harmonize with hardware as to material and finish. Provide machine screws and lead expansion shields to secure hardware to concrete, ceramic or quarry floor tile, or solid masonry. Fiber or rawl plugs and adhesives are not permitted. All fastenings exposed to weather shall be of nonferrous metal.

- G. After locks have been installed; show in presence of Project Engineer 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 Project Engineer 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 Project Engineer that upon completion, installer has visited the Project and has accomplished the following:
1. Re-adjust hardware.
 2. Evaluate maintenance procedures and recommend changes or additions, and instruct VA 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 Project Engineer 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.

ELECTRIC HARDWARE ABBREVIATIONS LEGEND: ADO = Automatic Door Operator EMCH = Electro-Mechanical Closer-Holder MHO = Magnetic Hold-Open (wall- or floor-mounted) UNK = Unknow
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INTERIOR SINGLE DOORS

HW-1

Each Door to Have:

NON-RATED

1	Continuous Hinge	A51031B
1	Push/Pull Plate Set	1894-4 x 1195-1 PULL (TRIMCO), OR EQUAL
1	Kick Plate	J102
1	Mop Plate (@ Inswing Doors)	J102

1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Floor Stop	L02121 x 3 FASTENERS
3	Silencers	L03011

HW-1A

Each Door to Have:

RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
		X HOSPITAL TIPS @ INSWING DOORS
1	Latchset	F01
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
		x INSTALL OUTSIDE ROOM
1	Kick Plate	J102
1	Mop Plate (@ Inswing Doors)	J102
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 mm width (2-1/4 inches)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Seals	R3C164

HW-1B

Each Door to Have:

NON-RATED/RATED

1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL
		X SWING-CLEAR X ADJUSTA-SCREWS
1	Hospital Latch	F01 x PADDLES POINTING DOWN
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Set Seals	R3C164

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	A51031B x INTEGRAL HINGE GUARD CHANNEL
		X SWING-CLEAR X ADJUSTA-SCREWS
1	Hospital Latch	F01 x PADDLES POINTING DOWN
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Mop Plate	J102
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
3	Silencers	L03011

HW-1E

Each Door to Have:

RATED

1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL
		X SWING-CLEAR X ADJUSTA-SCREWS
1	Hospital Latch	F01 x PADDLES POINTING DOWN

VA SAN DIEGO
HEALTHCARE SYSTEM

RENOVATE DENTAL TO AMBULATORY CARE (PHASE 3)
PROJECT# 664-12-118

1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Wall Stop (@ Inswing Doors)	L52101 CONVEX
1	Set Self-Adhesive Seals	R0E154

HW-1F

Each Door to Have:

NON-RATED

1	Continuous Hinge	A51031B
1	Latchset	F01
1	Kick Plate	J102
1	Wall Stop	L52101 CONVEX
3	Silencers	L03011

HW-1G

Each Door to Have:

NON-RATED

1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Latchset	F01
1	Kick Plate	J102
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Wall Stop	L52101 CONVEX
3	Silencers	L03011
1	Coat Hook	L03121

HW-1H

Each Dwarf Door to Have:

NON-RATED

1	Gate Spring Pivot Hinge	K13311
1	Secret Gate Latch	602 (ROCKWOOD), OR EQUAL
1	Wall Stop	L52101 CONVEX
2	Silencers	L03021

HW-1J

Each [MHO] Door to Have:

RATED

1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Latchset	F01
1	Closer	C02011/C02021 (PT4D, PT4H)
1	Heavy-Duty Armor Plate	J101 x 3.175 MM (0.125 INCH) THICKNESS
1	Lock Trim Protector Bar	R111LPB-630 (ROCKWOOD), OR EQUAL
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Magnetic Holder	C00011 TRI-VOLTAGE
1	Set Self-Adhesive Seals	R0E154

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

HW-1K

Each Door to Have:

NON-RATED

1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Hospital Latch	F01 x PADDLES POINTING DOWN
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0E154

HW-1L

Each Door to Have:

NON-RATED

1	Continuous Hinge	A51031B
1	Latchset	F01
1	Kick Plate	J102
1	Wall Stop	L52101 CONVEX
1	Threshold	J32300 x 57 mm width (2-1/4 inches)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0E154

HW-1M

Each Door to Have:

NON-RATED

1	Floor Closer	C06011 (PT8A, PT8J)
2	Push Plates	J304 8" x 16"
2	Kick Plates	J102
2	Edge Guard (@ Wood Doors)	J209M / J212 (VERIFY)
1	Overhead Stop	C01541-ADJUSTABLE

HW-1N

Each Door to Have:

NON-RATED

1	Continuous Hinge	A51031B
1	Push/Pull Plate Set	1894-4 x 1195-1 PULL (TRIMCO), OR EQUAL
1	Kick Plate	J102
1	Mop Plate (@ Inswing Doors)	J102
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Floor Stop	L02121 x 3 FASTENERS
3	Silencers	L03011

HW-1P

Each Lead-Lined Door to Have:

NON-RATED

1	Floor Closer	C6062 (PT8A, PT8G, PT8M)
2	Push Plates	J304 8" x 16"
2	Kick Plates	J102
2	Edge Guard (@ Wood Doors)	J209M / J212 (VERIFY)
1	Overhead Stop	C01541-ADJUSTABLE

<u>Each Door to Have:</u>		<u>HW-1Q</u>	<u>RATED/NON-RATED</u>
1	Continuous Hinge	A51031B	
1	Latchset	F01	
1	Kick Plate	J102	
1	Closer (@ rated doors)	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Closer (@ non-rated doors)	C02051/C02061 (PT4D, PT4H)	
1	Wall Stop	L52101 CONVEX	
1	Threshold	J32300 x 57 mm width (2-1/4 inches)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-1R</u>	<u>RATED/NON-RATED</u>
1	Continuous Hinge	A51031B	
1	Latchset	F01	
1	Kick Plate	J102	
1	Closer (@ rated doors)	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Closer (@ non-rated doors)	C02051/C02061 (PT4D, PT4H)	
1	Wall Stop	L52101 CONVEX	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-2</u>	<u>RATED/NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Keyed Privacy Indicator Lock	F13 x OCCUPANCY INDICATOR	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	
STONE THRESHOLD BY OTHER TRADES.			

<u>Each [ADO] Door to Have:</u>		<u>HW-2A</u>	<u>RATED/NON-RATED</u>
1	Continuous Transfer Hinge	A51031B 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	E59391 (FAIL-SECURE), 24VDC	
1	Power Supply	Regulated, Filtered, 24VDC, Amperage as required	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 mm width (2-1/4 inches)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Set Self-Adhesive Seals	R0E154	

AUTOMATIC DOOR OPERATOR AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.
STONE THRESHOLD BY OTHER TRADES.

<u>Each Door to Have:</u>		<u>HW-2B</u>	<u>NON-RATED</u>
1	Center Pivot Set	C07042	
1	Privacy Lock	F02-MOD x THUMBTURN BOTH SIDES X OCCUPANCY INDICATOR	
1	Rescue Stop	ES-1 (STANLEY), OR EQUAL	
1	Custom Rescue Strike	CUSTOM DOUBLE-LIPPED (TICE), OR EQUAL	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Wall Stop	L52101 CONVEX	
STONE THRESHOLD BY OTHER TRADES.			

<u>Each Door to Have:</u>		<u>HW-2C</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Privacy Lock	F02-MOD X OCCUPANCY INDICATOR	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Wall Stop	L52101 CONVEX	
3	Silencers	L03011	
STONE THRESHOLD BY OTHER TRADES.			

<u>Each Door to Have:</u>		<u>HW-2D</u>	<u>RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Privacy Lock	F02-MOD X OCCUPANCY INDICATOR	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Wall Stop	L52101 CONVEX	
1	Set Self-Adhesive Seals	R0E154	
STONE THRESHOLD BY OTHER TRADES.			

<u>Each Door to Have:</u>		<u>HW-2E</u>	<u>RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Hospital Privacy Latch	F02-MOD x TURNPIECE BOTH SIDES	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
1	Mop Plate (@ Inswing Doors)	J102	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Overhead Stop	C01541-ADJUSTABLE	
1	Set Self-Adhesive Seals	R0E154	
STONE THRESHOLD BY OTHER TRADES.			

<u>Each Door to Have:</u>		<u>HW-2F</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Privacy Lock	F02-MOD X OCCUPANCY INDICATOR	
1	Wall Stop	L52101 CONVEX	
3	Silencers	L03011	
1	Coat Hook	L03121	
		<u>HW-2G</u>	
<u>Each Door to Have:</u>			<u>RATED/NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Keyed Privacy Indicator Lock	F13 x OCCUPANCY INDICATOR	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Set Self-Adhesive Seals	R0E154	
STONE THRESHOLD BY OTHER TRADES.			
		<u>HW-2H</u>	
<u>Each Door to Have:</u>			<u>NON-RATED</u>
1	Continuous Hinge	A51031B 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 (@ Inswing Doors)	J102	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Overhead Stop	C01541-ADJUSTABLE	
3	Silencers	L03011	
STONE THRESHOLD BY OTHER TRADES.			
		<u>HW-2J</u>	
<u>Each Door to Have:</u>			<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Privacy Lock	F02-MOD X OCCUPANCY INDICATOR	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Wall Stop	L52101 CONVEX	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Set Self-Adhesive Seals	R0E154	
STONE THRESHOLD BY OTHER TRADES.			
		<u>HW-2K</u>	
<u>Each Door to Have:</u>			<u>NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL	

1	Hospital Privacy Latch	X ADJUSTA-SCREWS F02-MOD x TURNPIECE BOTH SIDES X OCCUPANCY INDICATOR
1	Kick Plate	J102
1	Mop Plate (@ Inswing Doors)	J102
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Set Self-Adhesive Seals	R0E154

STONE THRESHOLD BY OTHER TRADES.

Each Door to Have: HW-3 RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Office Lock	F04
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Kick Plate	J102
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154

Each Door to Have: HW-3A NON-RATED

THIS SET NOT USED.

Each Door to Have: HW-3B NON-RATED/RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Office Lock	F04
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Closer	CO2051/CO2061 (PT4D, PT4F, PT4H)
		AT NON-RATED
1	Floor Stop	L02121 x 3 FASTENERS
1	Door Viewer	L03221 - 190° (VIEW INTO CORRIDOR)
1	Set Self-Adhesive Seals	R0E154

OMIT VIEWER IF DOOR PROVIDED WITH VISION LITE.

THIS SET NOT USED. HW-3C

Each Door to Have: HW-3D RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Office Lock	F04
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Kick Plate	J102
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 mm width (2-1/4 inches)

1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0E154

HW-3E

Each Door to Have:

NON-RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Office Lock	F04
1	Closer	C02051/C02061 (PT4D, PT4H)
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154
1	Coat Hook	L03121

OMIT COAT HOOK WHERE GLASS LITE PREVENTS INSTALLATION.

HW-3F

Each Door to Have:

RATED/NON-RATED

1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Office Lock	F04
1	Closer	C02051/C02061 (PT4D, PT4H)
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H) @ RATED DOOR
1	Kick Plate	J102
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 mm width (2-1/4 inches)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0E154

HW-3G

Each Door to Have:

NON-RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Office Lock	F04
1	Closer	C02051/C02061 (PT4D, PT4H)
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 57 mm width (2-1/4 inches)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0E154

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	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Office Lock	F04
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)

1	Kick Plate	J102
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Sets Self-Adhesive Seals	R0E154

<u>Each Door to Have:</u>		<u>HW-3J</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Office Lock	F04	
1	Closer	C02051/C02061 (PT4D, PT4H)	
1	Kick Plate	J102	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 mm width (2-1/4 inches)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
1	Set Sound/Light Seals	R0C266	
1	Z-Bracket (as required for parallel arm closer)	770SPB (ZERO), OR EQUAL	

<u>Each Door to Have:</u>		<u>HW-4</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Classroom Lock	F08	
1	Overhead Stop	C04541	
3	Silencers	L03011	

<u>Each [ADO] Door to Have:</u>		<u>HW-4A</u>	<u>RATED</u>
1	Continuous Transfer Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL	
1	Classroom Lock	F08	
1	Electric Strike	E59311 (FAIL-SECURE), 24VDC	
1	Power Supply	Regulated, Filtered, 24VDC, Amperage as required	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102 @ TOILET ROOMS ONLY	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

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

POWER TRANSFER FOR RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

<u>Each Door to Have:</u>		<u>HW-4B</u>	<u>NON-RATED/RATED</u>
1	Continuous Hinge	A51031B	
1	Public Restroom Lock	F09	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Closer	C02051/C02061 (PT4D, PT4H)	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Floor Stop (@ Outswing Doors)	L02121 x 3 FASTENERS	
1	Wall Stop (@ Inswing Doors)	L52101 CONVEX	
1	Threshold	J32300 x 57 mm width (2-1/4 inches)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	
PROVIDE NON-HOLD-OPEN CLOSER AT TOILET ROOMS.			
STONE THRESHOLD BY OTHER TRADES.			

<u>Each Door to Have:</u>		<u>HW-4C</u>	<u>RATED</u>
1	Continuous Hinge	A51031B 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 (PT4D, PT4F, PT4H)	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Overhead Stop	C01541-ADJUSTABLE	
1	Threshold	J32300 x 57 mm width (2-1/4 inches)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
1	Set Seals	R3C164	

<u>Each Door to Have:</u>		<u>HW-4D</u>	<u>RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Classroom Lock	F08	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
1	Mop Plate (@ Inswing Doors)	J102	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop (@ Outswing Doors)	L02121 x 3 FASTENERS	
1	Wall Stop (@ Inswing Doors)	L52101 CONVEX	
1	Set Self-Adhesive Seals	R0E154	

HW-4E

Each Door to Have:

NON-RATED/RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Utility Lock	F09
1	Closer (@ rated doors)	C02011/C02021 (PT4D, PT4F, PT4H)
1	Closer (@ non-rated doors)	C02051/C02061 (PT4D, PT4F)
1	Kick Plate	J102
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 mm width (2-1/4 inches)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0E154

HW-4F

Each Door to Have:

RATED

1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Utility Lock	F09
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop (@ Outswing Doors)	L02121 x 3 FASTENERS
1	Wall Stop (@ Inswing Doors)	L52101 CONVEX
1	Set Self-Adhesive Seals	R0E154

HW-4G

Each Door to Have:

RATED/NON-RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Utility Lock	F09
1	Closer (@ Rated Doors)	C02011/C02021 (PT4D, PT4F, PT4H)
1	Closer (@ Non-rated Doors)	C02051/C02061 (PT4D, PT4H)
1	Kick Plate	J102
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154

HW-4H

Each [MHO] Door to Have:

RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Classroom Lock	F08
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Kick Plate	J102
1	Magnetic Holder	C00011 TRI-VOLTAGE
1	Set Self-Adhesive Seals	R0E154

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

<u>Each Door to Have:</u>		<u>HW-4J</u>	<u>RATED/NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Utility Lock	F09	
1	Closer (@ Rated Doors)	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Closer (@ Non-rated Doors)	C02051/C02061 (PT4D, PT4H)	
1	Kick Plate	J102	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 mm width (2-1/4 inches)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-4K</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Utility Lock	F09	
1	Closer	C02051/C02061 (PT4D, PT4H)	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-4L</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Classroom Lock	F08	
1	Closer	C02051/C02061 (PT4D, PT4H)	
1	Kick Plate	J102	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 mm width (2-1/4 inches)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
1	Set Sound/Light Seals	R0C266	
1	Z-Bracket (as required for parallel arm closer)	770SPB (ZERO), OR EQUAL	

<u>Each Door to Have:</u>		<u>HW-4M</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Classroom Hospital Lock	F08 x PADDLES POINTING DOWN	
1	Closer	C02051/C02061 (PT4D, PT4H)	
1	Heavy-Duty Armor Plate	J101 x 3.175 MM (0.125 INCH) THICKNESS	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-4N</u>	<u>RATED/NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Utility Lock	F09	
1	Closer (@ rated doors)	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Closer (@ non-rated doors)	C02051/C02061 (PT4D, PT4H)	
1	Kick Plate	J102	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 mm width (2-1/4 inches)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-4P</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Classroom Hospital Lock	F08 x PADDLES POINTING DOWN	
1	Closer	C02051/C02061 (PT4D, PT4H)	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Overhead Stop	C01541-ADJUSTABLE	
1	Threshold	J32300 x 57 mm width (2-1/4 inches)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-4Q</u>	<u>NON-RATED</u>
1	Pivot Set	C07162 x 454KG (1000 LBS) WEIGHT CAPACITY	
1	Intermediate Pivot	CO7311	
1	Utility Hospital Lock	F09 x LEAD-LINED x PADDLES POINTING DOWN	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Overhead Stop	C01541-ADJUSTABLE	
1	Set Self-Adhesive Seal	R0E154	

<u>Each [ADO] Door to Have:</u>		<u>HW-4R</u>	<u>RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL	
1	Classroom Lock	F08	
1	Electric Strike	E59311 (FAIL-SECURE), 24VDC	
1	Power Supply	Regulated, Filtered, 24VDC, Amperage as required	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102 @ TOILET ROOMS ONLY	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 mm width (2-1/4 inches)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Set Self-Adhesive Seals	R0E154	
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 RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS
PROVIDED BY SECTION 08 71 13).

<u>Each Door to Have:</u>		<u>HW-4S</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Classroom Lock	F08	
1	Closer	C02051/C02061 (PT4D, PT4H)	
1	Heavy-Duty Armor Plate	J101 x 3.175 MM (0.125 INCH) THICKNESS	
1	Lock Trim Protector Bar	R111LPB-630 (ROCKWOOD), OR EQUAL	
1	Edge Guard (@ 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	R0E154	

<u>Each Door to Have:</u>		<u>HW-4T</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Classroom Hospital Lock	F08 x PADDLES POINTING DOWN	
1	Closer	C02051/C02061 (PT4D, PT4H)	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Overhead Stop	C01541-ADJUSTABLE	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-4U</u>	<u>NON-RATED/RATED</u>
1	Continuous Hinge	A51031B	
1	Public Restroom Lock	F09	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Closer	C02051/C02061 (PT4D, PT4H)	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Floor Stop (@ Outswing Doors)	L02121 x 3 FASTENERS	
1	Wall Stop (@ Inswing Doors)	L52101 CONVEX	
1	Set Self-Adhesive Seals	R0E154	
PROVIDE NON-HOLD-OPEN CLOSER AT TOILET ROOMS.			
STONE THRESHOLD BY OTHER TRADES.			

<u>Each Lead-Lined Door to Have:</u>		<u>HW-4V</u>	<u>NON-RATED</u>
1	Pivot Set	C07162 x 454KG (1000 LBS) WEIGHT CAPACITY	
1	Intermediate Pivot	CO7311	
1	Utility Hospital Lock	F09 x LEAD-LINED x PADDLES POINTING DOWN	
1	Closer	CO2011/CO2021 (PT4D, PT4F, PT4H) x METAL LEAD-LINED COVER	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Overhead Holder-Stop	C01541-ADJUSTABLE	
1	Set Self-Adhesive Seal	R0E154	

<u>Each [ADO] Lead-Lined Door to Have:</u>		<u>HW-4X</u>	<u>NON-RATED</u>
1	Pivot Set	C07162 x 454KG (1000 LBS) WEIGHT CAPACITY	
1	Intermediate Transfer Pivot	CO7311 x 4 WIRE TRANSFER	
1	Utility Hospital Lock	F09 x LEAD-LINED x PADDLES POINTING DOWN	
1	Electric Unlatch Strike	MUNL (SECURITRON), OR EQUAL	
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Overhead Stop	C01541-ADJUSTABLE	
1	Set Self-Adhesive Seal	R0E154	
POWER TRANSFER PIVOT IS FOR RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).			
AUTO DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13.			

<u>Each [ADO] Door to Have:</u>		<u>HW-4Y</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B 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	MUNL (SECURITRON), OR EQUAL	
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Overhead Stop	C01541-ADJUSTABLE	
1	Set Self-Adhesive Seals	R0E154	
POWER TRANSFER PIVOT IS FOR RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).			
AUTOMATIC DOOR OPERATOR AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.			

<u>Each Door to Have:</u>		<u>HW-5</u>	<u>RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Storeroom Lock	F07	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Kick Plate	J102 (@ STORAGE, EVM, & HAC ROOMS ONLY)	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

HW-5A

THIS SET NOT USED.

<u>Each Door to Have:</u>		<u>HW-5B</u>	<u>RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Storeroom Lock	F07	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

HW-5C

THIS SET NOT USED.

<u>Each Door to Have:</u>		<u>HW-5D</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Storeroom Lock	F07	
1	Kick Plate	J102 (@ STORAGE, EVM, & HAC ROOMS ONLY)	
1	Floor Stop (@ Inswing Doors)	L02121 x 3 FASTENERS	
1	Wall Stop (@ Outswing Doors)	L52101 CONVEX	
3	Silencers	L03011	

<u>Each Door to Have:</u>		<u>HW-5E</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Storeroom Lock	F13-MOD x RIGID OUTSIDE LEVER x KEY RETRACTS DEADBOLT AND LATCHBOLT	
1	Closer	C02051/C02061 (PT4D, PT4H)	
1	Armor Plate	J101 x 3.125 MM (0.125 INCH) THICKNESS	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-5F</u>	<u>RATED/NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Storeroom Lock	F07	
1	Closer (@ Rated Doors)	C02011/C02021 (PT4D, PF4F, PT4H)	
1	Closer (@ Non-Rated Doors)	C02051/C02061 (PT4D, PT4H)	
1	Heavy-Duty Armor Plate	J101 x 3.175 MM (0.125 INCH) THICKNESS	
1	Lock Trim Protector Bar	R111LPB-630 (ROCKWOOD), OR EQUAL	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-5G</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Storeroom Lock	F07	
1	Kick Plate	J102	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	

<u>Each Dutch Door to Have:</u>		<u>HW-5H</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Dutch Door Bolt	L04161-4" @ Top Leaf	
1	Storeroom Lock	F07 @ Bottom Leaf	
1	Kick Plate	J102	
1	Floor Stop	L02121 x 3 FASTENERS @ Bottom Leaf	
1	Wall Stop	L01201 @ Top Leaf	
1	Set Self-Adhesive Seals	R0E154	
<u>Each Door to Have:</u>		<u>HW-5J</u>	<u>RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Storeroom Lock	F07	
1	Closer	C02011/C02021 (PT4D, PF4F, PT4H)	
1	Kick Plate	J102	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	
<u>Each Door to Have:</u>		<u>HW-5K</u>	<u>RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Storeroom Lock	F07	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	
<u>Each Door to Have:</u>		<u>HW-5L</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B 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	Closer	C02051/C02061 (PT4D, PT4H)	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-6</u>	<u>RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Exit Device	TYPE 1 F13 LEVER	
1	Key Cylinder	TYPE AS REQUIRED	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-6A</u>	<u>RATED</u>
1	Continuous Hinge	A51031B 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 (PT4D, PT4F, PT4H)	
1	Kick Plate	J102	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each [MHO] Door to Have:</u>		<u>HW-6B</u>	<u>RATED</u>
1	Continuous Hinge	A51031B 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 (PT4D, PT4H)	
1	Kick Plate	J102	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Magnetic Holder	C00011 TRI-VOLTAGE	
1	Set Self-Adhesive Seals	R0E154	
POWER, WIRING, CONDUIT, AND FIRE ALARM CONNECTION BY DIVISION 26.			

<u>Each Door to Have:</u>		<u>HW-6C</u>	<u>NON-RATED/RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Exit Device	TYPE 1 F08 LEVER	
1	Key Cylinder	TYPE AS REQUIRED	
1	Closer	C02021 (PT4D, PT4F, PT4H)	
1	Kick Plate	J102	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	

HW-6D

Each [ADO] Integrated Door to Have:

RATED

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

HW-6E

Each Door to Have:

NON-RATED

1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Exit Device	TYPE 1 F08 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Closer	C02051/C02061 (PT4D, PT4H)
1	Kick Plate	J102
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154

HW-6F

Each [ADO] Door to Have:

NON-RATED/RATED

1	Continuous Hinge	A51031B 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 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154

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

HW-6G

Each Door to Have:

NON-RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Exit Device	TYPE 1 F13 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0E154

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

HW-8A

Each Aluminum Storefront Pair to Have:

NON-RATED

2	Floor Closers	C06041 (PT8A, PT8F, PT8G, PT8J, PT8M)
2	Intermediate Pivots	C07321
2	Push/Pull Bar Sets	J505 - 305 MM (12 INCH) CENTER-TO-CENTER
		PULL
2	Overhead Stops	C01541-ADJUSTABLE

HW-8B

Each Pair to Have:

NON-RATED

2	Continuous Hinge	A51031B
2	Push Plate	J304 8" x 16"
2	Hospital Grip	J401
2	Kick Plate	J102
2	Mop Plate (@ Inswing Doors)	J102
2	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
2	Floor Stop	L02121 x 3 FASTENERS
2	Silencers	L03011

<u>Each Double-Acting Pair to Have:</u>		<u>HW-8C</u>	<u>NON-RATED</u>
2	Double-Acting Floor Closers	C06011 (PT8A, PT8G, PT8J, PT8M)	
4	Push Plates	J304 8" x 16"	
4	Heavy-Duty Armor Plates	J101 x 3.175 MM (0.125 INCH) THICKNESS	
4	Edge Guard (@ Wood Doors)	J209P / J212 (VERIFY)	
2	Overhead Holders	C01511-ADJUSTABLE	

<u>Each [ADO] Aluminum Storefront Pair to Have:</u>		<u>HW-8D</u>	<u>NON-RATED</u>
2	Pivot Sets	C07162	
2	Intermediate Transfer Pivots	C07321 x 4-WIRES	
2	Intermediate Pivots	C07321	
2	Push/Pull Bar Sets	J505 - 305 MM (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 RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).			
120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.			

<u>Each [ADO] Pair to Have:</u>		<u>HW-8E</u>	<u>NON-RATED</u>
2	Continuous Hinges	A51031B 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 (@ Inswing Doors)	J102	
2	Edge Guard (@ 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 RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).			

<u>Each [ADO] Pair to Have:</u>		<u>HW-8F</u>	<u>NON-RATED</u>
2	Continuous Hinges	A51031B 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 (@ Inswing Doors)	J102	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
2	Auto Door Bottoms	R0Y346 - HEAVY DUTY	
2	Set Self-Adhesive Seals	R0E154	
AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.			
POWER TRANSFERS FOR RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).			

HW-9

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

<u>Each Pair to Have:</u>		<u>HW-10</u>	<u>RATED</u>
2	Continuous Hinges	A51031B 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	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02011/C02021 (PT4D, PT4F, PT4H)	
2	Heavy-Duty Armor Plates	J101 x 3.175 MM (0.125 INCH) THICKNESS	
1	Lock Trim Protector Bar	R111LPB-630 (ROCKWOOD), OR EQUAL	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
2	Auto Door Bottoms	R0Y346 - HEAVY DUTY	
2	Set Self-Adhesive Seals	R0E154	
INSTALL LOCK TRIM PROTECTOR BAR ON PUSH SIDE OF ACTIVE LEAF TO PROTECT LEVER TRIM.			

<u>Each [ADO] Pair to Have:</u>		<u>HW-10A</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 8-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL	
1	Continuous Hinge	A51031B 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	MUNL (FAIL-SECURE), 24VDC (SECURITRON), OR EQUAL	
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED	
1	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS	
2	Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
2	Auto Door Bottoms	R0Y346 - HEAVY DUTY	
2	Set Self-Adhesive Seals	R0E154	
AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.			
POWER TRANSFER SHARED BY ELECTRIC STRIKE AND RE-ACTIVATION SENSOR WIRING (RE- ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).			

<u>Each Pair to Have:</u>		<u>HW-10B</u>	<u>NON-RATED/RATED</u>
2	Continuous Hinges	A51031B 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	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers (@ non-rated doors)	C02051/C02061 (PT4D, PT4H)	
2	Closers (@ rated doors)	C02011/C02021 (PT4D, PT4F, PT4H)	
2	Heavy-Duty Armor Plates	J101 x 3.175 MM (0.125 INCH) THICKNESS	
1	Lock Trim Protector Bar	R111LPB-630 (ROCKWOOD), OR EQUAL	
2	Edge Guard (@ 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.			

<u>Each Pair to Have:</u>		<u>HW-10C</u>	<u>NON-RATED</u>
2	Continuous Hinges	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT	
1	Utility Lock	F09	
1	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02051/C02061 (PT4D, PT4H)	
2	Kick Plates	J102	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	
<u>Each Pair to Have:</u>		<u>HW-10D</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
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	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02051/C02061 (PT4D, PT4H)	
2	Kick Plates	J102	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	
<u>Each Lead Lined Pair to Have:</u>		<u>HW-10E</u>	<u>NON-RATED</u>
2	Pivot Sets	C07162 x 454KG (1000 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	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS X LEAD-LINED	
2	Closers	C02051/C02061 (PT4D, PT4H)	
2	Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS	
4	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Pair to Have:</u>		<u>HW-10F</u>	<u>NON-RATED</u>
2	Continuous Hinges	A51031B 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	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02051/C02061 (PT4D, PT4H)	
2	Heavy-Duty Armor Plates	J101 x 3.175 MM (0.125 INCH) THICKNESS	
1	Lock Trim Protector Bar	R111LPB-630 (ROCKWOOD), OR EQUAL	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
2	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	
INSTALL LOCK TRIM PROTECTOR BAR ON PUSH SIDE OF ACTIVE LEAF TO PROTECT LEVER TRIM.			

<u>Each Pair to Have:</u>		<u>HW-10G</u>	<u>NON-RATED</u>
2	Continuous Hinges	A51031B 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	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02051/C02061 (PT4D, PT4H)	
2	Heavy-Duty Armor Plates	J101 x 3.175 MM (0.125 INCH) THICKNESS	
1	Lock Trim Protector Bar	R111LPB-630 (ROCKWOOD), OR EQUAL	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
2	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	
INSTALL LOCK TRIM PROTECTOR BAR ON PUSH SIDE OF ACTIVE LEAF TO PROTECT LEVER TRIM.			

<u>Each [ADO] Lead-Lined Pair to Have:</u>		<u>HW-10H</u>	<u>RATED/NON-RATED</u>
2	Bottom Pivots	C07162 LESS TOP PIVOT x 454KG (1000 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	MUNL (FAIL-SECURE), 24VDC (SECURITRON), OR EQUAL (LEAD-LINED)	
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED	
1	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS X LEAD-LINED	
2	Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS	
4	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Overhead Stops	C01541-ADJUSTABLE	
1	Set Self-Adhesive Seals	R0E154	
AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.			
POWER TRANSFER PIVOTS NEAR TOP OF EACH DOOR FOR RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).			

<u>Each [ADO] Pair to Have:</u>		<u>HW-10J</u>	<u>RATED/NON-RATED</u>
1	Continuous Transfer Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 8-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL	
1	Continuous Transfer Hinge	A51031B 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 Hospital Lock	F08 x PADDLES POINTING DOWN	
1	Electric Unlatch Strike	*MUNL (FAIL-SECURE), 24VDC (SECURITRON), OR EQUAL	
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED	
1	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS	
2	Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Overhead Stops	C01541-ADJUSTABLE	
1	Set Self-Adhesive Seals	R0E154	
AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.			
POWER TRANSFERS SHARED BY ELECTRIC STRIKE AND RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION 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.			

<u>Each [ADO] Pair to Have:</u>		<u>HW-10K</u>	<u>RATED/NON-RATED</u>
1	Continuous Transfer Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 8-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL	
1	Continuous Transfer Hinge	A51031B 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	MUNL (FAIL-SECURE), 24VDC (SECURITRON), OR EQUAL	
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED	
1	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS	
2	Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	
AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.			
POWER TRANSFER SHARED BY ELECTRIC STRIKE AND RE-ACTIVATION SENSOR WIRING (RE- ACTIVATION 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.			

<u>Each Pair to Have:</u>		<u>HW-10L</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
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	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02051/C02061 (PT4D, PT4H)	
2	Kick Plates	J102	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
2	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	

<u>Each Pair to Have:</u>		<u>HW-10M</u>	<u>NON-RATED</u>
2	Continuous Hinges	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT	
1	Utility Lock	F09	
1	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02051/C02061 (PT4D, PT4H)	
2	Kick Plates	J102	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
2	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	

<u>Each Pair to Have:</u>		<u>HW-11</u>	<u>RATED/NR</u>
	Hinges	QUANTITY & 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	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02011/C02021 (PT4D, PT4F, PT4H)	
2	Kick Plates	J102 (@ STORAGE ROOMS ONLY)	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Pair to Have:</u>		<u>HW-11A</u>	<u>NON-RATED</u>
2	Continuous Hinges	A51031B 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	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02051/C02061 (PT4D, PT4H)	
2	Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Pair to Have:</u>		<u>HW-11B</u>	<u>RATED</u>
2	Continuous Hinges	A51031B 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	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02011/C02021 (PT4D, PT4F, PT4H)	
2	Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS	
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each Pair to Have:</u>		<u>HW-11C</u>	<u>RATED/NR</u>
	Hinges	QUANTITY & 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	R5Y634 x R0E154 x THRU-BOLTS	
2	Closers	C02011/C02021 (PT4D, PT4F, PT4H)	
2	Kick Plates	J102 (@ STORAGE ROOMS ONLY)	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
2	Auto Door Bottoms	R0Y346 - HEAVY DUTY	
2	Set Self-Adhesive Seals	R0E154	

<u>Each Pair to Have:</u>		<u>HW-12</u>	<u>RATED</u>
	Hinges	QUANTITY & 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	R3E834	
2	Closers	C02011/C02021 (PT4D, PT4F, PT4H)	
2	Floor Stops	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

<u>Each [MHO] Pair Integrated Doors to Have:</u>		<u>HW-12A</u>	<u>RATED</u>
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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.

HW-12E

Each Pair to Have:

RATED

2	Continuous Hinges	A51031B 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	R3E834
2	Closers	C02011/C02021 (PT4D, PT4F, PT4H)
2	Kick Plates	J102
2	Edge Guard (@ 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	R0E154

HW-12F

Each Pair to Have:

RATED

	Hinges	QUANTITY & 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	R3E834
2	Closers	C02021 (PT4D, PT4F, PT4H)
2	Floor Stops	L02121 x 3 FASTENERS
2	Door Bottom	R0Y434 x NYLON BRUSH INSERT
2	Sets Self-Adhesive Seals	R0E154

HW-12G

Each Pair to Have:

NON-RATED

2	Continuous Hinges	A51031B 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	R3E834
2	Closers	C02051/C02071 (PT4D, PT4H)
2	Kick Plates	J102
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 x 3 FASTENERS
2	Door Bottom	R0Y434 x NYLON BRUSH INSERT
2	Sets Self-Adhesive Seals	R0E154

HW-12H

Each [ADO] Pair to Have:

NON-RATED

2	Continuous Transfer Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 8-THRUWIRE 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	R3E834
2	Kick Plates	J102
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 x 3 FASTENERS
2	Door Bottom	R0Y434 x NYLON BRUSH INSERT
2	Sets Self-Adhesive Seals	R0E154

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

HW-12J

Each Pair to Have:

RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Exit Device	TYPE 7 or 8 F01
1	Exit Device	TYPE 7 or 8 F13 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Set Meeting Stile Astragals	R3E834
2	Closers	C02011/C02021 (PT4D, PT4F, PT4H)
2	Floor Stops	L02121 x 3 FASTENERS
2	Door Bottom	R0Y434 x NYLON BRUSH INSERT
2	Sets Self-Adhesive Seals	R0E154

HW-13

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

NON-RATED

ALL HARDWARE BY SECTION 08 42 29.

EXTERIOR SINGLE DOORS

<u>Each Door to Have:</u>		<u>HW-E1</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B	
1	Entry Lock	F11	
1	Latch Protector (outswing dr)	MLP-111 (DON-JO), OR EQUAL	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Kick Plate	J102	
1	Floor Stop	1214CK x 1268CK (TRIMCO), OR EQUAL	
1	Threshold (outswing door)	J35130 x SILICONE GASKET	
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL	
1	Door Sweep	90100CNB (PEMKO), OR EQUAL	
1	Set Frame Seals	2891AS X CSK SCREWS (PEMKO), OR EQUAL	
1	Drip	R0Y976	
<u>Each Door to Have:</u>		<u>HW-E2</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B	
1	Classroom Lock	F05	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Kick Plate	J102	
1	Floor Stop	1214CK x 1268CK (TRIMCO), OR EQUAL	
1	Threshold (outswing door)	J35130 x SILICONE GASKET	
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL	
1	Door Sweep	90100CNB (PEMKO), OR EQUAL	
1	Set Frame Seals	2891AS X CSK SCREWS (PEMKO), OR EQUAL	
1	Drip	R0Y976	
<u>Each Door to Have:</u>		<u>HW-E3</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B 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)	MLP-111 (DON-JO), OR EQUAL	
1	Closer	C02011/C02021 (PT4D, PT4H)	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY),	
CUT: HARDWARE			
1	Armor Plate	J101 x 3.125 MM (0.125 INCH) THICKNESS	
1	Overhead Holder	C01511-ADJUSTABLE	
1	Threshold (outswing door)	J35130 x SILICONE GASKET	
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL	
1	Door Sweep	90100CNB (PEMKO), OR EQUAL	
1	Set Frame Seals	2891AS X CSK SCREWS (PEMKO), OR EQUAL	
1	Drip	R0Y976	

<u>Each Door to Have:</u>		<u>HW-E4</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B	
1	Anti-Vandal Pull	1097HASP (TRIMCO), OR EQUAL	
1	Exit Device	TYPE 1 F03 LES TRIM	
1	Key Cylinder	TYPE AS REQUIRED	
1	Closer	C02011 (PT4D, PT4F, PT4H)	
1	Kick Plate	J102	
1	Floor Stop	1214CK x 1268CK (TRIMCO), OR EQUAL	
1	Threshold	J35130 x SILICONE GASKET	
1	Door Sweep	90100CNB (PEMKO), OR EQUAL	
1	Set Frame Seals	2891AS X CSK SCREWS (PEMKO), OR EQUAL	
1	Drip	R0Y976	

<u>Each Roll-up Door to Have:</u>		<u>HW-E5</u>	<u>NON-RATED</u>
1	Padlock or 2 Cylinders	TYPE AS REQUIRED	
BALANCE OF HARDWARE BY SECTION 08 33 00, COILING DOORS AND GRILLES			

EXTERIOR PAIRS OF DOORS

<u>Each Pair to Have:</u>		<u>HW-E6</u>	<u>NON-RATED</u>
2	Continuous Hinge	A51031B	
1	Set Auto Flush Bolts	TYPE 25	
1	Dust Proof Strike	L04021	
1	Entry Lock	F11	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS	
1	Coordinator	TYPE 21A	
2	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
2	Kick Plate	J102	
2	Floor Stop	1214CK x 1268CK (TRIMCO), OR EQUAL	
1	Threshold (outswing door)	J35130 x SILICONE GASKET	
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL	
2	Door Sweep	90100CNB (PEMKO), OR EQUAL	
1	Set Frame Seals	2891AS X CSK SCREWS (PEMKO), OR EQUAL	
1	Drip	R0Y976	

<u>Each Pair to Have:</u>		<u>HW-E7</u>	<u>NON-RATED</u>
2	Continuous Hinge	A51031B	
1	Set Auto Flush Bolts	TYPE 25	
1	Dust Proof Strike	L04021	
1	Classroom Lock	F05	
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS	
1	Coordinator	TYPE 21A	
2	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
2	Kick Plate	J102	
2	Floor Stop	1214CK x 1268CK (TRIMCO), OR EQUAL	
1	Threshold (outswing door)	J35130 x SILICONE GASKET	
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL	
2	Door Sweep	90100CNB (PEMKO), OR EQUAL	
1	Set Frame Seals	2891AS X CSK SCREWS (PEMKO), OR EQUAL	
1	Drip	R0Y976	

<u>Each Pair to Have:</u>		<u>HW-E8</u>	<u>NON-RATED</u>
2	Continuous Hinge	A51031B	
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	R5Y634 x R0E154 x THRU-BOLTS	
1	Coordinator	TYPE 21A	
2	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
2	Armor Plate	J101 x 3.125 MM (0.125 INCH) THICKNESS	
2	Floor Stop	1214CK x 1268CK (TRIMCO), OR EQUAL	
1	Threshold (outswing door)	J35130 x SILICONE GASKET	
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL	
2	Door Sweep	90100CNB (PEMKO), OR EQUAL	
1	Set Frame Seals	2891AS X CSK SCREWS (PEMKO), OR EQUAL	
1	Drip	R0Y976	

<u>Each Door to Have:</u>		<u>HW-E9</u>	<u>NON-RATED</u>
2	Continuous Hinge	A51031B	
2	Anti-Vandal Pull	1097HASP (-NC @ INACTIVE LEAF) (TRIMCO), OR EQUAL	
1	Exit Device	TYPE 8 F01	
1	Exit Device	TYPE 8 F12 LESS PULL	
1	Key Cylinder	TYPE AS REQUIRED	
1	Set Meeting Stile Astragals	R3E834	
2	Closer	C02011 (PT4D, PT4F, PT4H)	
2	Kick Plate	J102	
2	Floor Stop	1214CK x 1268CK (TRIMCO), OR EQUAL	
1	Threshold	J35130 x SILICONE GASKET	
2	Door Sweep	90100CNB (PEMKO), OR EQUAL	
1	Set Frame Seals	2891AS X CSK SCREWS (PEMKO), OR EQUAL	
1	Drip	R0Y976	

<u>Each Sliding Door to Have:</u>		<u>HW-E10</u>	<u>NON-RATED</u>
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	1102T (TRIMCO), OR EQUAL	
1	Padlock or Sliding Door Lock	TYPE AS REQUIRED (PADLOCK) OR MS1850SN-450 (SLIDING DOOR LOCK) (ADAMS RITE, OR EQUAL	
2	Cylinder (for sliding dr lock)	TYPE AS REQUIRED	

EXTERIOR SINGLE GATES

<u>Each Traffic Gate to Have:</u>		<u>HW-G1</u>	<u>NON-RATED</u>
	Spring Hinge	TYPE REQUIRED X STAINLESS STEEL	
	BALANCE OF HARDWARE BY SECTION 32 31 33, CHAIN LINK FENCES AND GATES //		
	SECTION 32 31 19, DECORATIVE METAL FENCES AND GATES		

<u>Each Gate to Have:</u>		<u>HW-G2</u>	<u>NON-RATED</u>
2	Weldable Gate Hinges	I-8513 X WELDED OR FASTENED X SHEAR HINGE LEAVES TO FIT GATE MEMBERS (BROOKFIELD), OR EQUAL	
1	Weldable Lock Box	K-BXMOR X TYPE TO FIT LOCK BRAND/MODEL (KEEDEEX), OR EQUAL	
1	Utility Lock	F09 X NON-FERROUS LOCK CASE	
1	Stainless Steel Closer	C52011/C22021 (PT4D, PT4F, PT4H)	
	BALANCE OF HARDWARE BY SECTION 32 31 33, CHAIN LINK FENCES AND GATES //		
	SECTION 32 31 19, DECORATIVE METAL FENCES AND GATES		

<u>Each Gate to Have:</u>		<u>HW-G3</u>	<u>NON-RATED</u>
2	Weldable Gate Hinges	I-8513 X WELDED OR FASTENED X SHEAR HINGE LEAVES TO FIT GATE MEMBERS (BROOKFIELD), OR EQUAL	
1	Weldable Lock Box	K-BXMOR X TYPE TO FIT LOCK BRAND/MODEL (KEEDEEX), OR EQUAL	
1	Storeroom Lock	F13-MOD x RIGID OUTSIDE LEVER x KEY RETRACTS DEADBOLT AND LATCHBOLT	
1	Stainless Steel Closer	C52011/C22021 (PT4D, PT4F, PT4H)	
	BALANCE OF HARDWARE BY SECTION 32 31 33, CHAIN LINK FENCES AND GATES //		
	SECTION 32 31 19, DECORATIVE METAL FENCES AND GATES		

HW-G4

Each Gate to Have:

NON-RATED

2	Weldable Gate Hinges	I-8513 X WELDED OR FASTENED X SHEAR HINGE LEAVES TO FIT GATE MEMBERS (BROOKFIELD), OR EQUAL
1	Weldable Panic Box	K-BXED X TYPE TO FIT LOCK BRAND/MODEL (KEEDEX), OR EQUAL
1	Anti-Vandal Pull	1097HASP (TRIMCO), OR EQUAL
1	Rim Panic Device	TYPE 1 F03 LESS TRIM
1	Cylinder	TYPE AS REQUIRED
1	Stainless Steel Closer	C52011/C22021 (PT4D, PT4F, PT4H)

BALANCE OF HARDWARE BY SECTION 32 31 33, CHAIN LINK FENCES AND GATES // SECTION 32 31 19, DECORATIVE METAL FENCES AND GATES

HW-G5

Each Rolling or Swing-Up Gate to Have:

NON-RATED

1	Padlock or 2 Cylinders	TYPE AS REQUIRED
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BALANCE OF HARDWARE BY SECTION 32 31 33, CHAIN LINK FENCES AND GATES // SECTION 32 31 19, DECORATIVE METAL FENCES AND GATES

EXTERIOR PAIRS OF GATES

HW-G6

Each Pair Traffic Gates to Have:

NON-RATED

	Spring Hinge	TYPE REQUIRED X STAINLESS STEEL
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BALANCE OF HARDWARE BY SECTION 32 31 33, CHAIN LINK FENCES AND GATES // SECTION 32 31 19, DECORATIVE METAL FENCES AND GATES

HW-G7

Each Pair Gates to Have:

NON-RATED

4	Weldable Gate Hinges	I-8513 X WELDED OR FASTENED X SHEAR HINGE LEAVES TO FIT GATE MEMBERS (BROOKFIELD), OR EQUAL
2	Padlockable Cane Bolts with Hold-up Springs	524-P23 x P23SP x 524PL (1 STRIKE @ ACTIVE LEAF; 2 STRIKES AT INACTIVE LEAF) (CROWN INDUSTRIAL), OR EQUAL
2	Padlocks	TYPE AS REQUIRED
1	Weldable Lock Box	K-BXMOR X TYPE TO FIT LOCK BRAND/MODEL X K-BXSTR STRIKE BRACKET (KEEDEX), OR EQUAL
1	Utility Lock	F09 X NON-FERROUS LOCK CASE
2	Stainless Steel Closer	C52011/C22021 (PT4D, PT4F, PT4H)

BALANCE OF HARDWARE BY SECTION 32 31 33, CHAIN LINK FENCES AND GATES // SECTION 32 31 19, DECORATIVE METAL FENCES AND GATES.
INSTALL CANE BOLTS ON PULL SIDE OF EACH LEAF. ACTIVE LEAF CANE BOLT TO HAVE STRIKE IN OPEN POSITION ONLY. INACTIVE LEAF CANE BOLT TO HAVE STRIKES IN BOTH OPEN AND CLOSED POSITIONS.

<u>Each Pair Gates to Have:</u>		<u>HW-G8</u>	<u>NON-RATED</u>
4	Weldable Gate Hinges	I-8513 X WELDED OR FASTENED X SHEAR HINGE LEAVES TO FIT GATE MEMBERS (BROOKFIELD), OR EQUAL	
2	Padlockable Cane Bolts with Hold-up Springs	524-P23 x P23SP x 524PL (1 STRIKE @ ACTIVE LEAF; 2 STRIKES AT INACTIVE LEAF) (CROWN INDUSTRIAL), OR EQUAL	
2	Padlocks	TYPE AS REQUIRED	
1	Weldable Lock Box	K-BXMOR X TYPE TO FIT LOCK BRAND/MODEL X K-BXSTR STRIKE BRACKET (KEEDEEX), OR EQUAL	
1	Storeroom Lock	F13-MOD x RIGID OUTSIDE LEVER x KEY RETRACTS DEADBOLT AND LATCHBOLT	
2	Stainless Steel Closer	C52011/C22021 (PT4D, PT4F, PT4H)	
BALANCE OF HARDWARE BY SECTION 32 31 33, CHAIN LINK FENCES AND GATES //			
SECTION 32 31 19, DECORATIVE METAL FENCES AND GATES.			
INSTALL CANE BOLTS ON PULL SIDE OF EACH LEAF. ACTIVE LEAF CANE BOLT TO HAVE STRIKE IN OPEN POSITION ONLY. INACTIVE LEAF CANE BOLT TO HAVE STRIKES IN BOTH OPEN AND CLOSED POSITIONS.			

<u>Each Pair Gates to Have:</u>		<u>HW-G9</u>	<u>NON-RATED</u>
2	Weldable Gate Hinges	I-8513 X WELDED OR FASTENED X SHEAR HINGE LEAVES TO FIT GATE MEMBERS (BROOKFIELD), OR EQUAL	
2	Weldable Panic Boxes	K-BXED X TYPE TO FIT LOCK BRAND/MODEL (KEEDEEX), OR EQUAL	
1	Anti-Vandal Pull	1097HASP (-NC AT NON-KEYED PANIC) (TRIMCO), OR EQUAL	
1	Rim Panic Device	TYPE 1 F01	
1	Rim Panic Device	TYPE 1 F03 LESS TRIM	
1	Cylinder	TYPE AS REQUIRED	
2	Stainless Steel Closer	C52011/C22021 (PT4D, PT4F, PT4H)	
BALANCE OF HARDWARE AND FIXED MULLION BY SECTION 32 31 33, CHAIN LINK FENCES AND GATES //			
SECTION 32 31 19, DECORATIVE METAL FENCES AND GATES.			

<u>Each Rolling or Swing-Up Gate to Have:</u>		<u>HW-G10</u>	<u>NON-RATED</u>
1	Padlock or 2 Cylinders	TYPE AS REQUIRED	
BALANCE OF HARDWARE BY SECTION 32 31 33, CHAIN LINK FENCES AND GATES //			
SECTION 32 31 19, DECORATIVE METAL FENCES AND GATES			

RESIDENTIAL UNIT SINGLE DOORS

<u>Each Door to Have:</u>		<u>HW-R1</u>	<u>NON-RATED/RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Guestroom Card Lock	BY OTHER SECTION.	
1	Closer (@ Rated Doors)	C02011 (PT4D, PT4F PT4H)	
1	Floor Stop	L02121 x 3 FASTENERS	
2	Door Viewers	L03221 - 190°	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-R1A</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B	
1	Guestroom Card Lock	BY OTHER SECTION.	
1	Latch Protector (@ O/S Drs)	MLP-111 (DON-JO), OR EQUAL	
1	Closer	C02011/C02021 (PT4D, PT4F PT4H)	
1	Kick Plate	J102	
1	Floor Stop (@ I/S Doors)	L02121 x 3 FASTENERS	
1	Overhead Stop (@ O/S Doors)	C01541-ADJUSTABLE	
1	Threshold (outswing door)	J35130 x SILICONE GASKET	
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL	
1	Door Sweep	90100CNB (PEMKO), OR EQUAL	
1	Set Frame Seals	2891AS X CSK SCREWS (PEMKO), OR EQUAL	
1	Drip	R0Y976	

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

<u>Each Door to Have:</u>		<u>HW-R2A</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Push/Pull Plate Set	1894-4 x 1195-1 PULL (TRIMCO), OR EQUAL	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Floor Stop	L02121 x 3 FASTENERS	
3	Silencers	L03011	

<u>Each Door to Have:</u>		<u>HW-R2B</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Latchset	F75	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-R2C</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Push/Pull Plate Set	1894-4 x 1195-1 PULL (TRIMCO), OR EQUAL	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	

<u>Each Door to Have:</u>		<u>HW-R3</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Privacy	F76B	
1	Base Stop	L02031 x 3 FASTENERS	
1	Coat Hook	L03121	
3	Silencers	L03011	

<u>Each Door to Have:</u>		<u>HW-R3A</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Privacy	F76B	
1	Base Stop	L02031 x 3 FASTENERS	
1	Coat Hook	L03121	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	
AT TOILET ROOMS, OMIT METAL THRESHOLD; STONE THRESHOLD BY OTHER TRADES.			

<u>Each Door to Have:</u>		<u>HW-R4</u>	<u>RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED	
1	Classroom Lock	F84	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Base Stop	L02031 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	

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.

<u>Each Pair to Have:</u>		<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED
2	Dummy Sets	93K02DT (BEST), OR EQUAL
2	Roller Latches	E09091 x MORTISE STRIKE
2	Base Stops	L02031 x 3 FASTENERS
2	Silencers	L03011

<u>Each Door to Have:</u>		<u>NON-RATED/RATED</u>
	Hinges	QUANTITY & 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	R5Y634 x R0E154 x THRU-BOLTS
2	Closer (@ Rated Doors)	C02011 (PT4D, PT4F PT4H)
2	Floor Stop	L02121 x 3 FASTENERS
2	Door Viewers	L03221 - 190°
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
2	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0E154

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	FM-3500 X 83 1/8" X SEC. TORX (MARKAR), OR EQUAL
1	Pull	212C X SEC. TORX (SOUTHERN FOLGER), OR EQUAL
1	Lock	1080A-1 X HM MOUNT X SEC. TORX (SOUTHERN FOLGER), OR EQUAL
1	Strike/Keeper	4CL X SEC. TORX (SOUTHERN FOLGER), OR EQUAL
1	Overhead Stop	C01541-ADJUSTABLE X SEC. TORX
1	Door Position Switch	2757 X SEC. TORX (GE SECURITY), OR EQUAL

HW-SH-3

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

RATED/NON-RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Transfer Hinge	4-WIRE TYPE AS REQUIRED
1	Electrified Lock	F07 (E01-REX, E06) 24VDC
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0E154
1	Alarm Contact	1078-G (G.E. SECURITY), OR EQUAL

120VAC 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	A51031B
1	Push-button Combination Lock	N3 - A156.13 F07 G1 E06
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Kick Plate	J102
1	Mop Plate (@ Inswing Doors)	J102
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154

HW-SH-3C

Each [PB] Door to Have:

NON-RATED/RATED

1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Push-button Combination Lock	N3 - A156.13 F07 G1 E06
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154

HW-SH-3D

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

RATED

1	Continuous Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Electrified Lock	F07 (E01-REX, E06) 24VDC
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0E154
1	Alarm Contact	1078-G (G.E. SECURITY), OR EQUAL

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

HW-SH-3E

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

RATED

	Hinges	QUANTITY & TYPE AS REQUIRED
1	Transfer Hinge	4-WIRE TYPE AS REQUIRED
1	Electrified Occupancy Indicator Lock	F13-MODIFIED (E01-REX, E06) 24VDC X OCCUPANCY INDICATOR X KEY RETRACTS LATCHBOLT AND DEADBOLT X INTERNAL DEADBOLT MONITOR SWITCH
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 mm width (2-1/4 inches)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0E154
1	Alarm Contact	1078-G (G.E. SECURITY), OR EQUAL

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.

HW-SH-3F

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

RATED

1	Continuous Transfer Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 4-THRUWIRE 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) 24VDC
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154
1	Alarm Contact	1078-G (G.E. SECURITY), OR EQUAL

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

HW-SH-3G

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

1	Continuous Transfer Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 4-THRUWIRE 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) 24VDC
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Self-Adhesive Seals	R0E154
1	Alarm Contact	1078-G (G.E. SECURITY), OR EQUAL

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

HW-SH-3H

Each [AC, EL, REX, DPS] Door to Have: NON-RATED/RATED

1	Continuous Transfer Hinge	A51031B 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) 24VDC
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)
1	Kick Plate	J102
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154
1	Door Viewer	L03221 - 190°
1	Alarm Contact	1078-G (G.E. SECURITY), OR EQUAL

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

HW-SH-4B

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

RATED

1	Continuous Transfer Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 12-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Electrified Exit Device	TYPE 1 (E01-REX, E04) F13 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Power Supply	TYPE REQUIRED BY PANIC MANUFACTURER X ADO BOARD
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154

POWER TRANSFER **SHARED BY ELECTRIC PANIC AND** RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).
AUTOMATIC DOOR OPERATOR AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.

HW-SH-5

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

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.

HW-SH-9

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

RATED

	Hinges	QUANTITY & 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) 24VDC
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1	Coordinator	TYPE 21A
1	Overlapping Astragal with Self-Adhesive Seal	R5Y634 x R0E154 x THRU-BOLTS
2	Closers	C02011/C02021 (PT4D, PT4F, PT4H)
2	Kick Plates	J102 (@ STORAGE ROOMS ONLY)
2	Floor Stops	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154
2	Alarm Contacts	1078-G (G.E. SECURITY), OR EQUAL

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

HW-SH-9A

Each [PB] Pair to Have:

RATED

2	Continuous Hinge	A51031B 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	R5Y634 x R0E154 x THRU-BOLTS
2	Closers	C02011/C02021 (PT4D, PT4F, PT4H)
2	Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0E154

HW-SH-10

Each [AC, 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

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

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	A51031B x INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS
1	Passage Latch	F01 x LESS TRIM
1	Set Anti-Ligature Trim	CH (Accurate Lock), or equal
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Seals	R3C164

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.
NO CLOSER REQUIRED DUE TO EXEMPTION FOR PATIENT ROOM DOORS.

HW-MH1A

Each Door to Have:

RATED

	Hinges	QUANTITY & TYPE AS REQUIRED X HOSPITAL TIPS
1	Passage Latch	F01 x LESS TRIM
1	Set Anti-Ligature Trim	CH (Accurate Lock), or equal
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H) x INSTALL OUTSIDE ROOM
1	Kick Plate	J102
1	Mop Plate (@ Inswing Doors)	J102
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Seals	R3C164

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

<u>Each Door to Have:</u>		<u>HW-MH1B</u>	<u>RATED/NON-RATED</u>
1	Continuous Hinge	A51031B x HOSPITAL TIP	
1	Passage Latch	F01 x LESS TRIM	
1	Set Anti-Ligature Trim	CH (Accurate Lock), or equal	
1	Kick Plate	J102	
1	Closer (@ rated doors)	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Closer (@ non-rated doors)	C02051/C02061 (PT4D, PT4H)	
1	Wall Stop	L52101 CONVEX	
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
2	Sets Self-Adhesive Seals	R0E154	
INSTALL CLOSER OUTSIDE ROOM.			
PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.			

<u>Each Door to Have:</u>		<u>HW-MH2</u>	<u>NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED x HOSPITAL TIP	
1	Keyed Privacy Lock	F12-MOD x TURNPIECE BOTH SIDES x LESS TRIM	
1	Set Anti-Ligature Trim	CH (Accurate Lock), or equal	
2	Anti-Ligature Thumbturns	ALT-ADA-D/P (VERIFY) (Accuate Lock), or equal	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Auto Door Bottom	R0Y346 - HEAVY DUTY	
1	Set Seals	R3C164	
PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.			
STONE THRESHOLD BY OTHER TRADES.			

<u>Each Door to Have:</u>		<u>HW-MH2A</u>	<u>RATED/NON-RATED</u>
	Hinges	QUANTITY & TYPE AS REQUIRED x HOSPITAL TIP	
1	Keyed Privacy Indicator Lock	F13 x OCCUPANCY INDICATOR x LESS TRIM	
1	Set Anti-Ligature Trim	CH (Accurate Lock), or equal	
1	Anti-Ligature Thumbturn	ALT-ADA-D/P (VERIFY) (Accuate Lock), or equal	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Kick Plate	J102	
1	Mop Plate (@ Inswing Doors)	J102	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	
INSTALL CLOSER OUTSIDE ROOM			
PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.			
STONE THRESHOLD BY OTHER TRADES.			

<u>Each Door to Have:</u>		<u>HW-MH3</u>	<u>NON-RATED</u>
1	Continuous Hinge	A51031B 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 1.275 MM (0.050 INCH) THICKNESS	
1	Mop Plate	J102	
1	Edge Guard (@ 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	A51031B 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 (PT4D, PT4F, PT4H)	
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS	
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 x 3 FASTENERS	
1	Set Self-Adhesive Seals	R0E154	
INSTALL CLOSER OUTSIDE ROOM.			
PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.			

<u>Each [AC, RR, EL, REX, DPS] Door to Have:</u>		<u>HW-MH4</u>	<u>RATED</u>
1	Continuous Transfer Hinge	A51031B x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 4-THRUWIRE TRANSFER x IN-HINGE ACCESS PANEL	
1	Electrified Lock	F07 (E01-REX, E06) 24VDC x LESS TRIM	
1	Set Anti-Ligature Trim	CH (Accurate Lock), or equal	
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED	
1	Closer	C02011/C02021 (PT4D, PT4F, PT4H)	
1	Kick Plate	J102	
1	Stretcher Plate	J102	
1	Edge Guard (@ 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	R0E154	
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	A51031B x INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS
1	Lock	F08 x LESS TRIM
1	Set Anti-Ligature Trim	CH (Accurate Lock), or equal
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Seals	R3C164

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	A51031B x INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS
2	Anti-Ligature Pulls	DL34042 x BTB MOUNT (TRIMCO), OR EQUAL
1	Deadlatch	F30 LESS TRIM BOTH SIDES
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Seals	R3C164

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	A51031B x INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS
2	Anti-Ligature Pulls	DL34042 x BTB MOUNT (TRIMCO), OR EQUAL
1	Deadlatch	F30 LESS TRIM BOTH SIDES
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Armor Plate	J101 x 1.275 MM (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	A51031B x INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS
2	Anti-Ligature Pulls (act. 1f)	DL34042 x BTB MOUNT (TRIMCO), OR EQUAL
2	Manual Flush Bolts	L04251/L04261 (VERIFY)
1	Dust Proof Strike	L04021
1	Deadlatch	F30 LESS TRIM BOTH SIDES
1	Overlapping Astragal	R5Y634 x R0E154 x THRU-BOLTS
2	Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 x 3 FASTENERS
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
2	Auto Door Bottom	R0Y336 - HEAVY DUTY
1	Set Seals	R3C164

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

HW-MH6A

Each Pair to Have:

NON-RATED/RATED

2	Continuous Hinge	A51031B 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	CH (Accurate Lock), or equal
1	Overlapping Astragal	R5Y634 x R0E154 x THRU-BOLTS
2	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
2	Floor Stop	L02121 x 3 FASTENERS
1	Set Seals	R3C164

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

NO CLOSER REQUIRED DUE TO EXEMPTION FOR PATIENT ROOM DOORS.

- - - E N D - - -

SECTION 08 71 13

AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies equipment, controls and accessories for automatic operation of sliding doors.

1.2 RELATED WORK

- A. Aluminum frames entrance work; Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- B. Door hardware; Section 08 71 00, DOOR HARDWARE.
- C. Glass and glazing of doors and frames; Section 08 80 00, GLAZING.
- D. Electric general wiring, connections and equipment requirements; Division 26, ELECTRICAL.

1.3 QUALITY ASSURANCE

- A. Automatic door operators, controls and other equipment shall be products of a manufacturer regularly engaged in manufacturing such equipment for a minimum of three years.
- B. One type of automatic door equipment shall be used throughout the building.
- C. Equipment installer shall have specialized experience and shall be approved by the manufacturer.

1.4 WARRANTY

- A. Automatic door operators shall be subject to the terms of the "Warranty of Construction" Article of Section 00 72 00, GENERAL CONDITIONS, except that the Warranty period shall be two years in lieu of one year.

1.5 MAINTENANCE MANUALS

- A. In accordance with Section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS", furnish maintenance manuals and instructions on automatic door operators.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's literature and data describing operators, power units, controls, door hardware and safety devices.

C. Shop Drawings:

1. Showing location of controls and safety devices in relationship to each automatically operated door.
2. Showing layout, profiles, product components, including anchorage, accessories, as applicable.
3. Submit templates, wiring diagrams, fabrication details and other information to coordinate the proper installation of the automatic door operators.

D. Submit in writing to Project Engineer that items listed in Article 1.3 are in compliance.

1.7 DESIGN CRITERIA

- A. As a minimum automatic door equipment shall comply with the requirements of BHMA 156.10. Except as otherwise noted on drawings, provide operators which will move the doors from the fully closed to fully opened position in five seconds maximum time interval, when speed adjustment is at maximum setting.
- B. Equipment: Conforming to UL 325. Provide key operated power disconnect wall switch for each door installation.
- C. Electrical Wiring, Connections and Equipment: Provide all motor, starter, controls, associated devices, and interconnecting wiring required for the installation. Equipment and wiring shall be as specified in Division 26, ELECTRICAL.

1.8 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Builders Hardware Manufacturers Association, Inc. (BHMA):

A156.10-05..Power Operated Pedestrian Doors (BHMA 1601)
- C. National Fire Protection Association (NFPA):

101-09.....Life Safety Code
- D. Underwriters Laboratory (UL):

325-10.....Door, Drapery, Gate, Louver, and Window Operators and Systems

1.9 DELIVERY AND STORAGE

- A. Delivery shall be in factory's original, unopened, undamaged container with identification labels attached.

PART 2 - PRODUCTS

2.1 SWING DOOR OPERATORS

- A. General: To the extent practicable, new door operators in existing building shall match the existing operators as closely as possible. Swing door operators shall be of institutional type, door panel size 600 mm to 1250 mm (2'-0" to 5'-0") width, weight not to exceed 300 kg (600 pounds), electric operated for overhead mounting within the header or transom. Furnish metal mounting supports, brackets and other accessories necessary for the installation of operators at the head of the door frames. The motor on automatic door operator shall be provided with an interlock so that the motor will not operate when doors are electrically locked from opening.
- B. Operators shall have checking mechanism providing cushioning action at last part of door travel, in both opening and closing cycle. Operators shall be capable of recycling doors instantaneously to full open position from any point in the closing cycle when control switch is activated. Operators shall, when automatic power is interrupted or shut-off, permit doors to easily open manually without damage to automatic operator system.
- C. Operator, enclosed in housing, shall open door by energizing motor and shall stop by electrically reducing voltage and stalling motor against mechanical stop. Door shall close by means of spring energy, and close force shall be controlled by gear system and motor being used as dynamic break without power, or controlled by hydraulic closer in electro-hydraulic operators. System shall operate as manual door control in event of power failure. Opening and closing speeds shall be adjustable:
 - 1. Operator Housing: Housing shall be a minimum of 112 mm (4-1/2 inches) wide by 140 mm (5.5 inches) high aluminum extrusions with enclosed end caps for application to 100 mm (4 inches) and larger frame systems. All structural sections shall have a minimum thickness of 3.2 mm (0.125 inch) and be fabricated of a minimum of 6063-T5 aluminum alloy.
 - 2. Power Operator: Completely assembled and sealed unit which shall include gear drive transmission, mechanical spring and bearings, all located in aluminum case and filled with special lubricant for extreme temperature conditions. Complete unit shall be rubber mounted with provisions for easy maintenance and replacement, without removing door from pivots or frame.
 - 3. Connecting hardware shall have drive arm attached to door with a pin linkage rotating in a self-lubricating bearing. Door shall not pivot on shaft of operator.
 - 4. Electrical Control: Operator shall have a self contained electrical control unit, including necessary transformers, relays, rectifiers, and other electronic components for

proper operation and switching of power operator. All connecting harnesses shall have interlocking plugs.

2.2 MICROPROCESSOR CONTROLS

- A. The system shall include a multi-function microprocessor control providing adjustable hold open time (1-30 seconds), LED indications for sensor input signals and operator status and power assist close options. Control shall be capable of receiving activation signals from any device with normally open dry contact output. All activation modes shall provide fully adjustable opening speed:
- B. The door shall be held open by low voltage applied to the continuous duty motor. The control shall include an adjustable safety circuit that monitors door operation and stops the opening direction of the door if an obstruction is sensed. The motor shall include a recycle feature that reopens the door if an obstruction is sensed at any point during the closing cycle. The control shall include a standard three position key switch with functions for ON, OFF, and HOLD OPEN, mounted on operator enclosure, door frame, or wall, as indicated in the architectural drawings.

2.3 SLIDING DOOR OPERATORS

- A. General: Sliding doors shall have electric operators, conforming to BHMA A156.10 and the following requirements as applicable. Assembly shall be single or bi-parting sliding doors as shown on drawings.
- B. Door Operation: Doors shall be opened by electric motor pulling door from closed to open position and shall stop door by electrically reducing voltage and stalling door against mechanical stop. System shall permit manual control of door in event of power failure. Opening and closing speeds shall be adjustable. In compliance with NFPA-101, all door panels shall allow "breakout" to the full open position to provide instant egress at any point in the door's movement.
- C. Operators: Completely assembled and sealed electromechanical operating unit, all located in cast aluminum housing and filled with special lubricant for extreme conditions. Attached to transmission system shall be a minimum 1/8 Hp "DC" shunt-wound permanent magnet motor with sealed ball bearings. Complete unit shall be rubber mounted with provisions for easy maintenance and replacement. Operators shall have adjustable opening and closing cycle. Housing shall be minimum 6063T-5 alloy aluminum not less than .005 mm (125 inch) minimum thickness, 150 mm by 200 mm (6 inch wide by 8 inch high).
- D. Sliding Door Hardware Guide Rollers, Door Carrier: Top door carriers shall ride on steel or delrin rollers incorporating sealed bearings with each door having two support rollers and one anti-rise roller. Each roller shall have a minimum of 9 mm (3/8-inch) of vertical adjustment with positive mechanical locks. Each door shall also include two urethane covered oil impregnated

bearing bottom rollers attached with 5 mm (3/16-inch) thick formed steel guide brackets. Each door carrier supporting a door leaf shall include a vertical steel reinforcing member to prevent sagging when door is swung under breakaway conditions. All carbon steel brackets and fittings shall be plated for corrosion resistance.

- E. Locking Hardware: Do not provide any locking hardware at interior doors not requiring physical security. Provide doors with flush concealed vertical rod panic hardware integrated into the doors where physical security is required and free egress is required at all times. Provide doors with manufacturers' standard hookbolt lock (keyed both sides) where physical security is required and free egress is not required at all times. At doors with access control devices (card readers, etc.), provide doors with electronic deadbolt locking to prevent the doors from manually sliding open.
- F. Door Closers: Provide all breakout or swing-out panels with door closers concealed in the top rail of the door.

2.4 POWER UNITS

Each power unit shall be self-contained, electric operated and independent of the door operator. Capacity and size of power circuits shall be in accordance with automatic door operator manufacturer's specifications and Division 26 - ELECTRICAL.

2.5 DOOR CONTROLS

- A. Opening and closing actions of doors shall be actuated by controls and safety devices specified, and conform to ANSI 156.10. Controls shall cause doors to open instantly when control device is actuated; hold doors in open positions; then, cause doors to close, unless safety device or reactivated control interrupts operation.
 - 1. Floor control mats are NOT acceptable.
- B. Manual Controls:
 - 1. Push Plate Wall Switch: Recess type, stainless steel push plate minimum 100 mm by 100 mm (four-inch by four-inch), with 13 mm (1/2-inch) high letters "To Operate Door--Push" engraved on face of plate.
- C. Motion Detector: The motion detector may be surface mounted or concealed, to provide a signal to actuate the door operator, and monitor the immediate zone, to detect intrusion by persons, carts or similar objects. The zone which the detector monitors shall be 1500 mm (five feet) deep and 1500 mm (five feet) across, plus or minus 150 mm (six inches) on all dimensions. The maximum response time shall be no less than 25 milliseconds. Unit shall be designed to operate on 24 volts AC. The control shall not be affected by cleaning material, solvents, dust, dirt and outdoor weather conditions.

2.6 SAFETY DEVICES

- A. General: Area over which doors slide shall be a safety section and anyone standing in path of door's movement shall be protected by a safety device.
 - 1. Check with the VA to ensure that new safely devices are consistent with the existing safety system.
- B. At sliding doors, provide two photoelectric beams mounted at heights of 600 mm (24 inches) and 1200 mm (48 inches) in the door frame on sliding doors. Provide overhead safety presence sensors at door head on each side of the opening. Beams shall parallel door openings to prevent doors from closing when anyone is in the center of the door or doors. When beams are activated, doors shall recycle to full open position. Actuation shall include a motion detector mounted on each side of the door for detection of traffic in each direction.
- C. Time delay switches shall be adjustable between 3 to 60 seconds and shall control closing cycle of doors.
- D. Decals with sign "In" or "Do Not Enter" shall be installed on both faces of each door as directed by the VA.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate installation of equipment with other related work. Manual controls and power disconnect switches shall be recessed or semi-flush mounted in partitions. Secure operator components to adjacent construction with suitable fastenings. Conceal conduits, piping, and electric equipment, in finish work.
- B. Install power units in locations shown. Where units are to be mounted on walls, provide metal supports or shelves for the units. All equipment, including time delay switches, shall be accessible for maintenance and adjustment.
- C. Operators shall be adjusted and must function properly for the type of traffic (pedestrians, carts, stretchers and wheelchairs) expected to pass through doors. Each door leaf of pairs of doors shall open and close in synchronization. On pairs of doors, operators shall allow either door to be opened manually without the other door opening.
- D. Install controls at positions shown and make them convenient for particular traffic expected to pass through openings. Maximum height of push plate wall switches from finished floors shall be 40 inches unless otherwise approved by the Project Engineer.

3.2 INSTRUCTIONS

- A. Following the installation and final adjustments of the door operators, the installer shall fully instruct VA personnel for 2

hours on the operating, servicing and safety requirements for the swing and sliding automatic door operators.

- B. Coordinate instruction to VA personnel with VA Resident Engineer.

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SECTION 08 75 00

INSTALLATION OF DOORS AND HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

This section covers the hanging of metal doors, the fitting, preparation for hardware, and the installation of builder's hardware, and lock cylinders.

1.2 RELATED WORK

- A. Steel doors and frames, including fitting and preparation for hardware: Section 08 11 15, STEEL DOORS AND FRAMES AND WINDOW FRAMES.
- B. Door hardware and its location (height): Section 08 71 00, HARDWARE.

PART 2 - PRODUCTS

2.1 FASTENERS

- A. Use the fasteners furnished with the hardware to be installed. Where fasteners are not furnished with the item to be installed, use fasteners of suitable size and type to harmonize with the item to be installed as to material and finish and to suit the material to which fastened.
- B. Provide machine screws and metal expansion shields to secure hardware door assembly. Fiber, plastic, and lead or plugs and adhesives are not permitted.
- C. All fastenings exposed to weather shall be of non-ferrous metal.

PART 3 - EXECUTION

3.1 HARDWARE HEIGHTS

- A. Locate hardware on doors at heights specified below:
- B. Hardware Heights from Finished Floor:
 - 1. Locksets and latch sets centerline of strike 40-5/16 inches.
 - 2. Deadlocks centerline of strike 40-5/16 inches.
 - 3. Centerline of deadlock strike to be 33 inches when used with push-pull latch.

NOTE: Other hardware shall be located at standard commercial heights. Push and pull plates shall be located to prevent conflict with other hardware.

- C. Modifications, necessitated by reason of construction, shall be submitted to Project Engineer for approval before being made.

3.2 INSTALLATION, GENERAL

- A. Hang doors and install hardware when concrete work, and other operations which increase humidity and dust in the building, have been completed.
- B. All materials in areas where wood doors are to be hung shall be sufficiently dry so as to not affect the dimensional stability of the door.
- C. Install hardware, except hinges, after field painting.

3.3 INSTALLING DOORS AND BUILDER'S HARDWARE

- A. Install hardware at the location (heights) specified in accordance with the manufacturer's printed instructions.
- B. Drill and tap screw holes in steel frames and doors for surface mounted hardware.
- C. Use of shims will only be permitted at hinges where required to provide uniform clearance and alignment of door. Shims shall be cut from stainless steel sheet, same size as hinge.
- D. Screws shall not be driven in place.
- E. Hardware items shall be carefully fitted and securely attached to doors and frames.

3.4 CLEANING AND ADJUSTING

- A. Doors, including hardware shall be cleaned and adjusted to operate as designed without binding or deformation of the members.
- B. Doors shall be centered in the opening or frame and shall have all contact surfaces fit tight and even without forcing or warping the components.
- C. Installation of doors and frames that do not conform to hardware heights requirements is not acceptable and shall be replaced.
- D. After installation, clean all surfaces, remove temporary labels, paint spots and other defacement. Clean prefinished and plated items and all items fabricated from stainless steel, aluminum and copper alloys, as recommended by the manufacturer.

3.5 PROTECTION

- A. Protect doors and hardware from damage caused by weather or during construction until completion of the project.

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SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies glass, plastic, related glazing materials and accessories. Glazing products specified apply to factory or field glazed items.

1.2 RELATED WORK

- A. Factory glazed by manufacturer in following units:
 - 1. Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, and Section 08 14 00, WOOD DOORS.
 - 2. Section 08 41 13, Aluminum Framed Entrances and Storefronts.
 - 3. Color of spandrel glass, tinted Section 09 06 00, SCHEDULE FOR FINISHES.

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 Project Engineer.
- B. Permanent labels:
 - 1. Locate in corner for each pane.
 - 2. Label in accordance with ANSI Z97.1 and SGCC (Safety Glass Certification Council) label requirements.
 - a. Tempered glass.
 - b. Laminated glass or have certificate for panes without permanent label.
 - c. Organic coated glass.

1.4 PERFORMANCE REQUIREMENTS

- A. Building Enclosure Vapor Retarder and Air Barrier:

1. Utilize the inner pane of multiple pane sealed units for the continuity of the air barrier and vapor retarder seal.
 2. Maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.
- B. Glass Thickness:
1. Select thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with applicable California Building Code (CBC).
 2. Test in accordance with ASTM E 1300.
 3. Thicknesses listed are minimum. Coordinate thicknesses with framing system manufacturers.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Certificates:
1. Certificates stating that wire glass, meets requirements for safety glazing material as specified in ANSI Z97.1.
 2. Certificate on shading coefficient.
 3. Certificate on "R" value when value is specified.
 4. Certificate test reports confirming compliance's with specified bullet resistive rating.
- C. Warranty: Submit written guaranty, conforming to General Condition requirements, and to "Warranty of Construction" Article in this Section.
- D. Manufacturer's Literature and Data:
1. Glass, each kind required.
 2. Insulating glass units.
 3. Elastic compound for metal sash glazing.
 4. Glazing cushion.
 5. Sealing compound.
- E. Samples:
1. Size: 150 mm by 150 mm (6 inches by 6 inches).
 2. Tinted glass.

3. Reflective glass.

- F. Preconstruction Adhesion and Compatibility Test Report: Submit glazing sealant manufacturer's test report indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Schedule delivery to coincide with glazing schedules so minimum handling of crates is required. Do not open crates except as required for inspection for shipping damage.
- B. Storage: Store cases according to printed instructions on case, in areas least subject to traffic or falling objects. Keep storage area clean and dry.
- C. Handling: Unpack cases following printed instructions on case. Stack individual windows on edge leaned slightly against upright supports with separators between each.

1.7 PROJECT CONDITIONS

Field Measurements: Field measure openings before ordering tempered glass products. Be responsible for proper fit of field measured products.

1.8 WARRANTY

- A. Warranty: Conform to terms of "Warranty of Construction", FAR clause 52.246-21, except extend warranty period for the following:
1. Bullet resistive plastic material to remain visibly clear without discoloration for 10 years.
 2. Insulating glass units to remain sealed for 10 years.
 3. Laminated glass units 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):
- Z97.1-04.....Safety Glazing Material Used in Building -
Safety Performance Specifications and Methods
of Test.
- C. American Society for Testing and Materials (ASTM):

C1363-05.....Thermal Performance of Building Assemblies, by
Means of A Hot Box Apparatus

C542-05.....Lock-Strip Gaskets.

C716-06.....Installing Lock-Strip Gaskets and Infill
Glazing Materials.

C794-06.....Adhesion-in-Peel of Elastomeric Joint Sealants.

C864-05.....Dense Elastomeric Compression Seal Gaskets,
Setting Blocks, and Spacers.

C920-08.....Elastomeric Joint Sealants.

C964-07.....Standard Guide for Lock-Strip Gasket Glazing.

C1036-06.....Flat Glass.

C1048-04.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated
and Uncoated Glass.

C1172-09.....Laminated Architectural Flat Glass.

C1376-10.....Pyrolytic and Vacuum Deposition Coatings on
Flat Glass.

D635-06.....Rate of Burning and/or Extent and Time of
Burning of Self-Supporting Plastic in a
Horizontal Position.

D4802-02.....Poly (Methyl Methacrylate) Acrylic Plastic
Sheet.

E84-09.....Surface Burning Characteristics of Building
Materials.

E1300-09.....Determining Load Resistance of Glass in
Buildings.

E2190-08.....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; 1977, with 1984 Revision.

F. National Fire Protection Association (NFPA):

80-08.....Fire Doors and Windows.

G. National Fenestration Rating Council (NFRC)

- H. Safety Glazing Certification Council (SGCC)2009:
Certified Products Directory (Issued Semi-Annually).
- I. Underwriters Laboratories, Inc. (UL):
752-06.....Bullet-Resisting Equipment.
- J. Unified Facilities Criteria (UFC):
4-010-01-2007.....DOD Minimum Antiterrorism Standards for
Buildings
- K. Glass Association of North America (GANA):
Glazing Manual (Latest Edition)
Sealant Manual (2008)
- L. American Society of Civil Engineers (ASCE):
ASCE 7-10.....Wind Load Provisions

PART 2 - PRODUCTS

2.1 GLASS

- A. Use the products indicated on the drawings, and in the thickness
stated unless specified otherwise in assemblies.
- B. Clear Glass:
 - 1. ASTM C1036, Type I, Class 1, Quality.
 - 2. Thickness, as indicated.
 - 3. Coordinate color/tint/coating to comply with the selections
made by the Architect.
- C. Tinted Heat reflective and low emissivity coated glass:
 - 1. ASTM C1036, Type I, Class 2, Quality q3.
 - 2. Color: As selected by the architect.
 - 3. Thickness, indicated on the drawings.

2.2 HEAT-TREATED AND FULLY TEMPERED GLASS

- A. Clear Heat Strengthened Glass:
 - 1. ASTM C1048, Kind HS, Condition A, Type I, Class 1, Quality
q3.
 - 2. Thickness, as indicated on the drawings.

B. Clear Tempered Glass:

1. ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.
2. Thickness, as indicated on the drawings.

C. Tinted Tempered Glass.

1. ASTM C1048, Kind FT, Condition A, Type I, Class 2, Quality q3.
2. Color: As selected by the Architect.
3. Thickness as indicated on the drawings.

2.3 COATED GLASS

A. Spandrel Glass:

1. ASTM C1048, Kind HS, Condition B, Type I.
2. Thickness, as indicated on the drawings.

B. Reflective Tempered Glass:

1. ASTM C1048, Kind FT, Condition C, Type I, Class 1, Quality q3 with reflective metallic coating, having nominal values of 25 percent day light, 30 percent solar, and 7.9 percent ultraviolet transmittance within three percent plus or minus.
2. Thickness, as indicated on the drawings.

C. Low-E Tempered Glass:

1. ASTM C1048, Kind FT, Condition C, Type I, Class 1, Quality q3 with low emissivity pyrolytic coating having an E of 0.15.
2. Apply coating to second or third surface of insulating glass units as standard with the product manufacturer.
3. Thickness, as indicated on the drawings.

D. Ceramic Coated Spandrel Glass:

1. ASTM C1048, Kind FT, Condition B, Type I, Class 1, Quality q3 with ceramic coating applied over and fused into glass surface.
2. Pattern as indicated in drawings, or as selected by the Architect.
3. Apply coating to second surface.
4. Thickness, as indicated on the drawings.

2.4 LAMINATED GLASS

- A. Two or more lites of glass bonded with an interlayer material for use in building glazing
- B. Colored Interlayer:
 - 1. Use color interlayer ultraviolet light color stabilization.
 - 2. Option: Use colored interlayer with clear glass in lieu of tinted glass and clear interlayer.
 - 3. Option: Use white interlayer with clear glass in lieu of obscure glass and clear interlayer.
 - 4. The interlayer assembly shall have uniform color presenting same appearance as tinted glass assembly.
- C. Use 1.5 mm (0.060 inch) thick interlayer for:
 - 1. Horizontal or Sloped glazing.
 - 2. Acoustical glazing.
 - 3. Heat strengthened or fully tempered glass assemblies.
- D. Use min. 0.75 mm (0.030 inch) thick interlayer for vertical glazing where 1.5 mm (0.060 inch) interlayer is not otherwise shown or required.

2.5 INSULATING GLASS UNITS

- A. Provide factory fabricated, hermetically sealed glass unit consisting of two panes of glass separated by a dehydrated air space and comply with ASTM E2190.
- B. Assemble units using glass types indicated on the drawings.
- C. Sealed Edge Units (SEU):
 - 1. Insulating Glass Unit Makeup
 - a. Outboard Lite
 - 1) Glass type:
 - 2) Glass Tint:
 - 3) Nominal Thickness:
 - 4) Glass Strength: (Annealed, Heat-Strengthened, Tempered)
 - b. Spacer
 - 1) Nominal Thickness:
 - 2) Gas Fill: (Air or 90% Argon)

c. Inboard Lite

- 1) Glass Type:
- 2) Glass Tint:
- 3) Nominal Thickness:
- 4) Glass Strength: (Annealed, Heat-Strengthened, Tempered)

3. Glass shall be annealed, heat strengthened or tempered as required by codes, as required to meet thermal stress and wind loads, or indicated on the drawings.
4. Glass heat-treated by horizontal (roller hearth) process with inherent roller wave distortion parallel to the bottom edge of the glass as installed when specified.

D. Fused Edge Units, (FEU):

1. Glass to glass sealed edges electrically fused.
2. Air space not less than 4.8 mm (3/16 inch) wide up to 6 mm (1/4 inch) wide.
3. R value not less than 1.5.

E. FEU Clear Glass.

1. Interior and exterior panes, ASTM C1036, Type I, Class 1, Quality q3, 3 mm (1/8 inch) thick.
2. Thickness, 11 mm (7/16 inch) minimum.

2.6 FIRE RESISTANT GLASS WITHOUT WIRE MESH

A. Fire resistant glass or glass assembly classified by UL in Building Materials Directory or other approved testing laboratory bearing permanent mark of classification.

B. Firelite.

1. UL listing R13377-1, 4.8 mm (3/16 inch) thick, unpolished.
2. Distributed by Technical Glass Products; Kirkland, WA 98033.

C. Pyrovue Commercial.

1. UL listing R10178(N), 41 mm (1-5/8 inch) thick.
2. Represented by Advanced Glass Systems Corporation, Trumbauersville, PA 18970-0051

2.7 GLAZING ACCESSORIES

- A. As required to supplement the accessories provided with the items to be glazed and to provide a complete installation. Ferrous metal accessories exposed in the finished work shall have a finish that will not corrode or stain while in service.
- B. Setting Blocks: ASTM C864:
 - 1. Channel shape; having 6 mm (1/4 inch) internal depth.
 - 2. Shore a hardness of 80 to 90 Durometer.
 - 3. Block lengths: 50 mm (two inches) except 100 to 150 mm (four to six inches) for insulating glass.
 - 4. Block width: Approximately 1.6 mm (1/16 inch) less than the full width of the rabbet.
 - 5. Block thickness: Minimum 4.8 mm (3/16 inch). Thickness sized for rabbet depth as required.
- C. Spacers: ASTM C864:
 - 1. Channel shape having a 6 mm (1/4 inch) internal depth.
 - 2. Flanges not less 2.4 mm (3/32 inch) thick and web 3 mm (1/8 inch) thick.
 - 3. Lengths: One to 25 to 76 mm (one to three inches).
 - 4. Shore a hardness of 40 to 50 Durometer.
- D. Sealing Tapes:
 - 1. Semi-solid polymeric based material exhibiting pressure-sensitive adhesion and withstanding exposure to sunlight, moisture, heat, cold, and aging.
 - 2. Shape, size and degree of softness and strength suitable for use in glazing application to prevent water infiltration.
- E. Spring Steel Spacer: Galvanized steel wire or strip designed to position glazing in channel or rabbeted sash with stops.
- F. 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.
- G. Lock-Strip Glazing Gaskets: ASTM C542, shape, size, and mounting as indicated.

- H. 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.
- I. 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.
- J. 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: As selected by the Architect.
 - 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 with details, dimensions and tolerances indicated on manufacturer's approved shop drawings.
- B. Advise Contractor of conditions which may adversely affect glass and glazing unit installation, prior to commencement of installation: Do not proceed with installation until unsatisfactory conditions have been corrected.

- C. Verify that wash down of adjacent masonry is completed prior to erection of glass and glazing units to prevent damage to glass and glazing units by cleaning materials.

3.2 PREPARATION

- A. For sealant glazing, prepare glazing surfaces in accordance with GANA-02 Sealant Manual.
- B. Determine glazing unit size and edge clearances by measuring the actual unit to receive the glazing.
- C. Shop fabricate and cut glass with smooth, straight edges of full size required by openings to provide GANA recommended edge clearances.
- D. Verify that components used are compatible.
- E. Clean and dry glazing surfaces.
- F. Prime surfaces scheduled to receive sealants, as determined by preconstruction sealant-substrate testing.

3.3 INSTALLATION - GENERAL

- A. Install in accordance with GANA-01 Glazing Manual and GANA-02 Sealant Manual unless specified otherwise.
- B. Glaze in accordance with recommendations of glazing and framing manufacturers, and as required to meet the Performance Test Requirements specified in other applicable sections of specifications.
- C. Set glazing without bending, twisting, or forcing of units.
- D. Do not allow glass to rest on or contact any framing member.
- E. Glaze doors and operable sash, in a securely fixed or closed and locked position, until sealant, glazing compound, or putty has thoroughly set.
- F. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.
- G. Laminated Glass:
 - 1. Tape edges to seal interlayer and protect from glazing sealants.
 - 2. Do not use putty or glazing compounds.
- H. Insulating Glass Units:
 - 1. Glaze in compliance with glass manufacturer's written instructions.

2. When glazing gaskets are used, they shall be of sufficient size and depth to cover glass seal or metal channel frame completely.
 3. Do not use putty or glazing compounds.
 4. Do not grind, nip, cut, or otherwise alter edges and corners of fused glass units after shipping from factory.
 5. Install with tape or gunnable sealant in wood sash.
- I. Fire Resistant Glass:
1. Wire glass: Glaze in accordance with NFPA 80.
 2. Other fire resistant glass: Glaze in accordance with UL design requirements.

3.4 INSTALLATION - WET/DRY METHOD (PREFORMED TAPE AND SEALANT)

- A. Cut glazing tape to length and set against permanent stops, 5 mm (3/16 inch) below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- B. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
- C. Place setting blocks at 1/4 points with edge block no more than 150 mm (6 inches) from corners.
- D. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to achieve full contact at perimeter of pane or glass unit.
- E. Install removable stops, with spacer strips inserted between glazing and applied stops, 6 mm (1/4 inch) below sight line. Place glazing tape on glazing pane or unit with tape flush with sight line.
- F. Fill gap between glazing and stop with elastomeric type sealant to depth equal to bite of frame on glazing, but not more than 9 mm (3/8 inch) below sight line.
- G. Apply cap bead of sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.5 REPLACEMENT AND CLEANING

- A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by Project Engineer.
- B. Replace cracked, broken, and imperfect glass, or glass which has been installed improperly.

- C. Leave glass, putty, and other setting material in clean, whole, and acceptable condition.

3.6 PROTECTION

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

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SECTION 09 06 00

COLOR AND DESIGN

PART 1 -GENERAL

1.1 DESCRIPTION:

This section includes physical data requirements for materials specified and shown on the drawings.

1.2 RELATED WORK:

Refer to specific items identified.

1.3 MANUFACTURER'S REQUIREMENT:

Refer to "Manufacturers Qualifications" for specific requirements.

1.4 SUBMITTALS:

In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWING, furnish the following:

A. Shop Drawing:

1. Where specifically requested, shop drawing will be submitted identifying all parts by name, kind of material and showing construction, installation and anchorage.

B. Manufacturer's Literature & Data Sheets:

1. Indicating manufacturer's qualifications, physical data and warranties.

PART 2 - MATERIALS

2.1 FLOOR COVERING

A. Resilient Or Composition Floor Tile:

1. 12 in. X 12 in. X 1/8 in. tiles laid on the square, directional pattern alternating to adjacent tiles, to meet Fed. Specs. SS-T-312B (1) Type IV, Composition 1.

B. CARPET ROLL GOODS:

1. 28 oz. square yard, Fire Rating Class A, Smoke density 450 or less, ASTM E-662, direct glue down ASTM E-648.

C. VINYL HOMOGENOUS SHEET FLOORING

1. Heat welded seams, .080" heavy gauge, 6 FT wide, ASTM Rating to meet ASTM E-648, Class 1, Smoke density 450 or less, 100 PSI.

D. CERAMIC FLOOR TILE:

1. 1 in. X 1 in. non-skid, 7.5% abrasive, cushion edge, straight joints, color of grout to match tile

2.2 WALL COVERING

A. RUBBER BASE:

1. 4 & 6 inch high, .080 Ga.

B. PAINT:

1. Water base interior semi-gloss enamel, AA, Light Reflectance IAW ASTM E-97-55. All doors and metal work shall be brush finish.

C. VINYL:

1. 22 oz. per square yard, 54" wide, 4" RPT, R-2 insulation value, Flame Spread Class A, Acrylic backing ASTM E-84 to be hung vertically, floor to ceiling with patterns and textures to match per manufacturers directions.

D. SISAL:

1. 48 to 51 oz. per square yard, 48 to 96" wide, Flame Spread Class A ASTM E-84, Sound Absorption .65%.

E. ACOUSTICAL:

1. 16 Oz. per square yard, 48 to 54" wide, Flame Spread Class A ASTM E-84, Sound Absorption .82%, NRC Rating - ASTM C-423.85A.

F. CERAMIC GLAZED BASE & WALL TILE:

1. 4 1/4 in. X 4 1/4 in. base, field & trimmers, joints to align vertically and horizontally, color of grout to match tile.

2.3 DOOR PROTECTION

A. KICKPLATE:

1. Stainless steel, 16 gauge. Refer to Section 08 71 00 "Hardware".

B. ARMORPLATE:

1. Stainless steel, 16 gauge. Refer to Section 08 71 00 "Hardware".

C. FRAME:

1. High impact acrylic plastic, surface mounted, 16 gauge.

2.4 PROTECTION GUARDS

A. BUMPER GUARD:

1. 8 in. high, High impact acrylic plastic, bumper rail mounted 16 gauge.

B. CORNER GUARD:

1. 3 in. wide, stainless steel, surface mounted, 16ga.

C. CRASH RAIL:

1. 4 in. wide, stainless steel, bumper rail mounted, 16ga.

D. HANDRAIL:

1. 5 1/2 in. high, high-impact acrylic plastic, bumper rail mounted.
2. 1 1/4 in. diameter stainless steel, surface mounted.

2.5 CEILING

A. CEILING TILE:

1. 24 in. X 24 in. x 5/8 in. or 24 in. X 48 in. X 5/8 in. Fire rated Class A, Acoustical Lay-In Tile.

B. CEILING GRID:

1. 2 ft. X 2 ft. or 2 ft. X 4 ft. pattern, baked white enamel, 1 in. wide.

2.6 TOILET COMPARTMENTS (TBD)

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SECTION 09 22 16

NON-STRUCTURAL FRAMING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section covers steel stud wall and ceiling systems, wall furring, fasteners, and accessories.

1.2 RELATED WORK

- 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 is specified in decimals of an inch and is the minimum bare (uncoated) steel thickness.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS:
 - 1. Manufacturer's Literature and Data:
 - a. Studs, runners and accessories.
 - b. Hanger inserts.
 - c. Channels (Rolled steel).
 - e. Furring channels.
 - f. Screws, clips and other fasteners.

1.4 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

- A. In accordance with the requirements of ASTM C754.

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)
 - A525-87.....Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 - A641-82.....Zinc-Coated (Galvanized) Carbon-Steel Wire

- C11-87.....Definitions of Terms Relating to Gypsum
and related Building and Systems
- C635-87.....Metal Suspension System for Acoustical
Tile and Lay-in Panel Ceilings.
- C636-86.....Installation of Metal Suspension Systems
for Acoustical Tile and Lay-in Panels.
- C645-83.....Non-Load (Axial) Bearing Steel Studs,
Runners (Track), and Rigid Furring
Channels for Screw Application of Gypsum
Board
- C754-82.....Installation of Steel Framing Members to
Receive Screw-Attached Gypsum Wallboard,
Backing Board or Water-Resistant Backing
Board
- C841-87.....Installation of Interior Lathing and
Furring
- C1002-83.....Steel Drill Screws for the Application of
Gypsum Board
- C. Federal Specification (Fed. Spec.):
 - FF-P-395B.....Pin, Drive, Guided And Pin Drive, Power
Actuated (Fasteners For Powder Actuated
And Hand Actuated Fastening Tools

PART 2 - PRODUCTS

2.1 PROTECTIVE COATING

- A. Protect steel studs, runners (track), rigid (hat section) furring channels, "Z" shaped furring channels, and resilient furring channels, with not less than G60 galvanizing per ASTM A525.

2.2 STEEL STUDS AND RUNNERS (TRACK)

- A. ASTM C645.
 - 1. Use ASTM A525 steel.
 - 2. Runners same thickness as studs.
- B. Provide not less than two 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.
- D. Studs 12 feet or less in length shall be in one piece.

2.3 FASTENERS, CLIPS, AND OTHER METAL ACCESSORIES

- A. ASTM C754, except as otherwise specified.
- B. Fasteners for steel studs thicker than 0.033-inch thick shall be steel drill screws of size and type recommended by the manufacturer of the material being fastened.

- C. Clips: ASTM C841 (paragraph 6.11), manufacturers 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.
- D. Attachments for Wall Furring:
 - 1. Manufacturers standard items fabricated from zinc-coated (galvanized) steel sheet.
 - 2. For concrete or masonry walls: Metal slots with adjustable inserts or adjustable wall furring brackets. Spacers may be fabricated from 0.0396-inch thick galvanized steel with corrugated edges.
- E. Power Actuated Fasteners:
 - 1. Fed. Spec. FF-P-395.
 - 2. Fastener length and Class as required to resist twice the imposed loads; style suitable for type of hanger or bracket used.
 - 3. Eye Pin: Type I, Class 4, Style EP.
 - 4. Threaded Stud: Style SC for concrete; Style SS for steel.
 - 5. Drive Pins: Style PC for concrete, Style PS for steel.
 - 6. For applications not specified, type and size as recommended by the manufacturer of the material being fastened.

2.4 SUSPENDED CEILING SYSTEM FOR GYPSUM BOARD (OPTION)

- A. Conform to ASTM C635, heavy duty, with not less than 35 mm (1-3/8 inch) wide knurled capped flange face designed for screw attachment of gypsum board.
- B. Wall track channel with 35 mm (1-3/8 inch) wide flange.

PART 3 - EXECUTION

3.1 INSTALLING STUDS

- A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.
- B. Space studs not more than 16 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. Openings:
 - 1. Frame jambs of openings in stud partitions and furring with two 0.0341-inch thick steel studs placed back to back or as shown.
 - 2. Fasten back to back studs together with 3/8-inch long Type S panhead screws at not less than two feet on center, staggered along webs.

3. Studs fastened flange to flange shall have splice plates on both sides approximately two inches by three inches screwed to each stud with two screws in each stud. Locate splice plates at 24 inches on center between runner tracks.
- E. Fastening Studs:
1. Fasten studs located adjacent to partition intersections, corners and studs at jambs of openings to flange of runner tracks with either two screws through each end of each stud and flange of runner, or by use of metal lock fastener tool.
 2. Do not fasten studs to top runner track when studs extend to underside of structure overhead.
- F. Chase Wall Partitions:
1. Locate cross braces for chase wall partitions to permit the installation of pipes, conduits, carriers and similar items.
 2. Studs or runners used as cross bracing shall be not less than 2-1/2 inches wide.
- G. Form building seismic or expansion joints with double studs back to back spaced three inches apart plus the width of the seismic or expansion joint.
- H. Form control joint, with double studs spaced 1/2-inch apart.

3.2 CEILING SYSTEMS

- A. Installing suspended ceiling system for gypsum board (ASTM C635 Option):
1. Install only for ceilings to receive screw attached gypsum board.
 2. Install in accordance with ASTM C636.
 - a. Install main runners spaced 1200 mm (48 inches) on center.
 - b. Install 1200 mm (four foot) tees not over 600 mm (24 inches) on center; locate for edge support of gypsum board.
 - c. Install wall track channel at perimeter.
- B. Installing Ceiling Bracing System:
1. Brace suspended ceiling or soffit framing in seismic areas in accordance with ASTM E580.
 2. Construct bracing of 38 mm (1-1/2 inch) channels for lengths up to 2400 mm (8 feet) and 50 mm (2 inch) channels for lengths over 2400 mm (8 feet) with ends bent to form surfaces for anchorage to carrying channels and over head construction. Lap channels not less than 600 mm (2 feet) at midpoint back to back. Screw or bolt lap together with two fasteners.

3. Install bracing at an approximate 45 degree angle to carrying channels and structure overhead; secure as specified to structure overhead with two fasteners and to carrying channels with two fasteners or wire ties.

3.3 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, wood seats, toilet stall partitions, dressing booth partitions, urinal screens, chalkboards, tackboards, wall-hung casework, handrail brackets, recessed fire extinguisher cabinets and other items 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.

3.4 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.

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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 09 22 16, NON-STRUCTURAL METAL FRAMING.
- B. Sound deadening board: Section 07 21 13, THERMAL INSULATION.
- C. Acoustical Sealants: Section 07 92 00, JOINT SEALANTS.

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.
 - 5. Cementitious Backer Board
- C. Shop Drawings:
 - 1. Typical gypsum board installation, showing corner details, edge trim details and the like.
 - 2. Typical sound rated assembly, showing treatment at perimeter of partitions and penetrations at gypsum board.
 - 3. Typical shaft wall assembly.

D. Samples:

1. Cornerbead.
2. Edge trim.
3. Control joints.

E. Test Results:

1. Fire rating test, each fire rating required for each assembly.
2. Sound rating test.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

- 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):

C11-07.....Terminology Relating to Gypsum and Related
Building Materials and Systems

C475-02.....Joint Compound and Joint Tape for
Finishing Gypsum Board

C840-07.....Application and Finishing of Gypsum Board

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

C1396-06.....Gypsum Board

E84-07.....Surface Burning Characteristics of
Building Materials

E497-99.....Installing Sound Isolating Lightweight
Partitions

- C. Underwriters Laboratories Inc. (UL):
Latest Edition.....Fire Resistance Directory
- D. Inchcape Testing Services (ITS):
Latest Editions.....Certification Listings

PART 2 - PRODUCTS

2.1 GYPSUM BOARD

- A. Gypsum Board: ASTM C1396, Type X, 16 mm (5/8 inch) thick unless shown otherwise. Shall contain a minimum of 20 percent recycled gypsum.
- B. Coreboard or Shaft Wall Liner Panels.
 - 1. ASTM C1396, Type X.
 - 2. Coreboard for shaft walls 300, 400, 600 mm (12, 16, or 24 inches) wide by required lengths 25 mm (one inch) thick with paper faces treated to resist moisture.
- C. Cementitious Backing Board: Provide one of the following, as indicated:
 - 1. Cementitious Backing Panels: Water-resistant cementitious panels reinforced with a fiberglass scrim, complying with ANSI A118.9, Durock, Hardibacker 500, or equal.
 - 2. Screws for board attachment: ASTM C 1002.
- D. Water Resistant Gypsum Backing Board: ASTM C620, Type X, 16 mm (5/8 inch) thick.
- E. Gypsum cores shall contain 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, 16 mm (5/8 inch) thick.
- B. ASTM C1177, Type X.

2.3 ACCESSORIES

- A. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.
- B. Flanges not less than 22 mm (7/8 inch) wide with punchouts or deformations as required to provide compound bond.

2.4 FASTENERS

- A. ASTM C1002 and ASTM C840, except as otherwise specified.
- B. ASTM C954, for steel studs thicker than 0.04 mm (0.33 inch).

- C. Select screws of size and type recommended by the manufacturer of the material being fastened.
- D. For fire rated construction, type and size same as used in fire rating test.
- E. Clips: Zinc-coated (galvanized) steel; gypsum board manufacturer's standard items.

2.5 FINISHING MATERIALS AND LAMINATING ADHESIVE

- 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 shown (FHP).
 - 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 100 mm (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. Use gypsum boards in maximum practical lengths to minimize number of end joints.
- D. Bring gypsum board into contact, but do not force into place.
- E. 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.
- F. Walls (Except Shaft Walls):
 - 1. When gypsum board is installed parallel to framing members, space fasteners 300 mm (12 inches) on center in field of the board, and 200 mm (8 inches) on center along edges.
 - 2. When gypsum board is installed perpendicular to framing members, space fasteners 300 mm (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 except gypsum board shall be applied vertically over "Z" furring channels.
 - 5. For two-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 three-ply gypsum board assemblies, apply plies in same manner as for two-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 two-ply assembly, except use fasteners of sufficient length enough to have the same penetration into framing members as required for two-ply assemblies.
 - 7. No offset in exposed face of walls and partitions will be permitted because of single-ply and two-ply or three-ply application requirements.
 - 8. Installing Two Layer Assembly Over Sound Deadening Board:
 - a. Apply face layer of wallboard vertically with joints staggered from joints in sound deadening board over framing members.

- b. Fasten face layer with screw, of sufficient length to secure to framing, spaced 300 mm (12 inches) on center around perimeter, and 400 mm (16 inches) on center in the field.
- 9. 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 9000 mm (30 feet).
 - c. Extend control joints the full height of the wall or length of soffit/ceiling membrane.
- G. Acoustical or Sound Rated Partitions, Fire and Smoke Partitions:
 - 1. Cut gypsum board for a space approximately 3 mm to 6 mm (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. Follow ASTM E497 for sound rated partitions. STC minimum values as shown.
- H. Accessories:
 - 1. Set accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces as specified.
 - 2. Install in one piece, without the limits of the longest commercially available lengths.
 - 3. Corner Beads:
 - a. Install at all vertical and horizontal external corners and where shown.
 - b. Use screws only. Do not use crimping tool.
 - 4. Edge Trim (casings Beads):
 - a. At both sides of expansion and control joints unless shown otherwise.
 - b. Where gypsum board terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.
 - c. Where gypsum board surfaces of non-load bearing assemblies abut load bearing members.
 - d. Where shown.

3.3 CAVITY SHAFT WALL

- A. Coordinate assembly with Section 09100, 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 (Nonbearing for two-hour fire rating or 25-1/HR (Non-loadbearing) for one-hour fire rating where shown.
- C. Cut coreboard (liner) panels 25 mm (one inch) less than floor-to-ceiling height, and erect vertically between J-runners on shaft side.
 - 1. Where shaft walls exceed 4300 mm (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.
- 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 25 mm (one inch) long screws, spaced 600 mm (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 300 mm (12 inches) on center.
 - 2. One hour wall with one 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 300 mm (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.

3.4 FINISHING OF GYPSUM BOARD

- A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use Level 5 finish for all finished areas open to public view.
- B. Before proceeding with installation of finishing materials, assure the following:
 - 1. Gypsum board is fastened and held close to framing or furring.

2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.
- C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of non decorated 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.

3.5 REPAIRS

- A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including nondecorated surfaces.
- B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.
- C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 inch) thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.
- D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide 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

This section specifies ceramic or porcelain tile as indicated on the drawings and specified.

1.2 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, 225 mm by 225 mm (9 inches by 9 inches), each type, color, size and pattern.
 - 3. Paver tile, each size, type, color and pattern.
 - 4. Quarry tile, each type, color, and size.
 - 5. Porcelain tile, each type, color, patterns and size.
 - 6. Wall (or wainscot) tile, each color, size and pattern.
 - 7. 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.
 - 8. Therapeutic pool tile, panels 300 mm (12 inches) square, each type, size, color, typical lettering and special shapes.
- C. Product Data:
 - 1. Ceramic and porcelain tile, marked to show each type, size, and shape required.
 - 2. Chemical resistant mortar and grout (Epoxy and Furan).
 - 3. Cementitious backer unit.
 - 4. Dry-set Portland cement mortar and grout.
 - 5. Divider strip.
 - 6. Elastomeric membrane and bond coat.
 - 7. Reinforcing tape.
 - 8. Leveling compound.
 - 9. Latex-Portland cement mortar and grout.
 - 10. Commercial Portland cement grout.

- 11. Organic adhesive.
- 12. Slip resistant tile.
- 13. Waterproofing isolation membrane.
- 14. 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. Organic adhesive.
 - k. Waterproof isolation membrane.
 - l. Factory mounted tile suitability for application in wet area specified under 2.1, A, 3 with list of successful in-service performance locations.

1.3 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.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.
- B. American National Standards Institute (ANSI):
 - A10.20-05.....Safety Requirements for Ceramic Tile, Terrazzo, and Marble Works
 - A108.1A-05.....Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar

- A108.1B-05.....Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with dry-Set or latex-Portland Cement Mortar
- A108.1C-05.....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
- A108.4-05.....Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesives
- A108.5-05.....Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
- A108.6-05.....Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy
- A108.8-05.....Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout
- A108.10-05.....Installation of Grout in Tilework
- A108.11-05.....Interior Installation of Cementitious Backer Units
- A108.13-05.....Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone
- A118.1-05.....Dry-Set Portland Cement Mortar
- A118.3-05.....Chemical Resistant, Water Cleanable Tile-Setting Epoxy and Water Cleanable Tile-Setting and Grouting Epoxy Adhesive
- A118.4-05.....Latex-Portland Cement Mortar
- A118.5-05.....Chemical Resistant Furan Mortars and Grouts for Tile Installation
- A118.6-05.....Standard Cement Grouts for Tile Installation
- A118.9-05.....Cementitious Backer Units
- A118.10-05.....Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation
- A136.1-05.....Organic Adhesives for Installation of Ceramic Tile
- A137.1-88.....Ceramic Tile

C. American Society For Testing And Materials (ASTM):

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

- C109/C109M-07.....Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch. or [50-mm] Cube Specimens)
- C241-90 (R2005)...Abrasion Resistance of Stone Subjected to Foot Traffic
- C348-02.....Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars
- C627-93(R2007)....Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester
- C954-07.....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
- C979-05.....Pigments for Integrally Colored Concrete
- C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Panel Products
- C1027-99(R2004)...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
- C1127-01.....Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with an Integral Wearing Surface
- C1178/C1178M-06...Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel
- D4397-02.....Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
- D5109-99(R2004)...Standard Test Methods for Copper-Clad Thermosetting Laminates for Printed Wiring Boards
- D. Marble Institute of America (MIA): Design Manual III-2007
- E. Tile Council of America, Inc. (TCA):
2007.....Handbook for Ceramic Tile Installation

PART 2 - PRODUCTS

2.1 TILE

- A. Comply with ANSI A137.1, Standard Grade, except as modified:
1. Inspection procedures listed under the Appendix of ANSI A137.1.
 2. Abrasion Resistance Classification:

- a. Tested in accordance with values listed in Table 1, ASTM C 1027.
- b. Class V, 12000 revolutions for floors in Corridors, Kitchens, Storage including Refrigerated Rooms
- c. Class IV, 6000 revolutions for remaining areas.
- 3. Slip Resistant Tile for Floors:
 - a. Coefficient of friction, when tested in accordance with ASTM C1028, required for level of performance:
 - 1) Not less than 0.7 (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. Tile Having Abrasive Grains:
 - 1) Unglazed Ceramic Mosaic Tile: Abrasive grains throughout body of the tile.
 - 2) Quarry Tile: Abrasive grains uniformly embedded in face at rate of approximately 7.5 percent of surface area.
- 4. Mosaic tile may be mounted or joined together by a resinous bonding material along tile edges.
- 5. 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.
- 6. 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.
- B. Unglazed Ceramic Mosaic Tile: Nominal 6 mm (1/4 inch) thick with cushion edges.
- C. Unglazed Quarry Tile: Nominal 13 mm (1/2 inch) thick, square edges.
- D. Glazed Wall Tile: Cushion edges, glazing, as specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- E. Porcelain Paver Tile: Nominal 8 mm (5/16 inch) thick, with cushion edges. Porcelain tile produced by the dust pressed method shall be made of approximately 50% feldspar; the remaining 50% shall be

made up of various high-quality light firing ball clays yielding a tile with a water absorption rate of 0.5% or less and a breaking strength of between 390 to 400 pounds.

F. Trim Shapes:

1. Conform to applicable requirements of adjoining floor and wall tile.
2. Use slip resistant trim shapes for horizontal surfaces of showers.
3. Use trim shapes sizes conforming to size of adjoining field wall tile including existing spaces unless detailed or specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.
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 unglazed ceramic mosaic and glazed wall tile installed in Portland cement mortar setting bed, use cove and bullnose shapes as applicable. When ceramic mosaic wall and base tile is required, use C Series cove and bullnose shapes.
 - i. For unglazed ceramic mosaic and glazed wall tile installed in dry-set Portland cement mortar, latex-Portland cement mortar, and organic adhesive (thin set methods), use cove and surface bullnose shapes as applicable.
 - j. For quarry tile work, use cove and bullnose shapes as applicable.

2.2 CEMENTITIOUS BACKER UNITS

- A. Use in showers or wet areas.
- B. ANSI A118.9.

- C. Use Cementitious backer units in maximum available lengths.
- D. Backer unit meet or exceed the following additional physical properties:

<u>Property</u>	<u>Test Method</u>	<u>Value</u>
Water absorption	ASTM C948	Less than 20 percent by weight

2.3 JOINT MATERIALS FOR CEMENTITIOUS BACKER UNITS

- A. Reinforcing Tape: Vinyl coated woven glass fiber mesh tape, open weave, 50 mm (2 inches) wide. Tape with pressure sensitive adhesive backing will not be permitted.
- B. Tape Embedding Material: Latex-Portland cement mortar complying with ANSI A118.4.
- C. Joint material, including reinforcing tape, and tape embedding material, shall be as specifically recommended by the backer unit manufacturer.

2.4 FASTENERS

- A. Screws for Cementitious Backer Units.
 - 1. Standard screws for gypsum board are not acceptable.
 - 2. Minimum 11 mm (7/16 inch) diameter head, corrosion resistant coated, with washers.
 - 3. ASTM C954 for steel 1 mm (0.033 inch) thick.
 - 4. ASTM C1002 for steel framing less than 0.0329 inch thick.
- B. Washers: Galvanized steel, 13 mm (1/2 inch) minimum diameter.

2.5 GLASS MAT WATER RESISTANT GYPSUM BACKER BOARD

Confirm to ASTM C1178/C1178M, Optional System for Cementitious Backer Units.

2.6 SETTING MATERIALS OR BOND COATS

- A. Conform to TCA Handbook for Ceramic Tile Installation.
- B. Portland Cement Mortar: ANSI A108.1.
- C. Latex-Portland Cement Mortar: ANSI A118.4.
 - 1. For wall applications, provide non-sagging, latex-Portland cement mortar complying with ANSI A118.4.
 - 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 A118.1. For wall applications, provide non-sagging, latex-Portland cement mortar complying with ANSI A118.4.
- E. Organic Adhesives: ANSI A136.1, Type 1.

F. Chemical-Resistant Bond Coat:

1. Epoxy Resin Type: ANSI A118.3.
2. Furan Resin Type: ANSI A118.5.

G. Elastomeric Waterproofing Membrane and Bond Coat:

1. TCA F122-02.
2. ANSI A118.10.
3. One component polyurethane, liquid applied material having the following additional physical properties:
 - a. Hardness: Shore "A" between 40-60.
 - b. Elongation: Between 300-600 percent.
 - c. Tensile strength: Between 40-60 psig.
 - d. No volatile compounds.
4. Coal tar modified urethanes are not acceptable.

H. 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-37 degrees C (-25 degrees F)	ASTM D2497 13 mm (1/2- inch) Mandrel Bend
Retention of Properties after Heat Aging	Percent of original	80 Tensile 80 Breaking 80 Elongation	ASTM D3045, 90 degrees C (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 A118.6.
2. Use one part white Portland cement to one part white sand passing a number 30 screen.
3. Color additive not permitted.

C. Commercial Portland Cement Grout: ANSI A118.6 color as specified.

D. Dry-Set Grout: ANSI A118.6 color as specified.

E. Latex-Portland Cement Grout: ANSI A118.6 color as specified.

1. Unsanded grout mixture for joints 3.2 mm (1/8 inch) and narrower.
2. Sanded grout mixture for joints 3.2 mm (1/8 inch) and wider.

F. Chemical-Resistant Grout:

1. Epoxy grout, ANSI A118.3.
2. Furan grout, ANSI A118.5.

2.8 PATCHING AND LEVELING COMPOUND

A. Portland cement base, polymer-modified, self-leveling compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.

B. Shall have minimum following physical properties:

1. Compressive strength - 25 MPa (3500 psig) per ASTM C109/C109M.
2. Flexural strength - 7 MPa (1000 psig) per ASTM C348 (28 day value).
3. Tensile strength - 600 psi per ANSI 118.7.
4. Density - 1.9.

- C. Capable of being applied in layers up to 38 mm (1-1/2 inches) thick without fillers and up to 100 mm (four inches) thick with fillers, being brought to a feather edge, and being trowelled to a smooth finish.
- D. Primers, fillers, and reinforcement as required by manufacturer for application and substrate condition.
- E. Ready for use in 48 hours after application.

2.9 MARBLE

- A. Soundness Classification in accordance with MIA Design Manual III Groups.
- B. Thresholds:
 - 1. Group A, Minimum abrasive hardness (Ha) of 10.0 per ASTM C241.
 - 2. Honed finish on exposed faces.
 - 3. Thickness and contour as shown.
 - 4. Fabricate from one piece without holes, cracks, or open seams; full depth of wall or frame opening by full width of wall or frame opening; 19 mm (3/4-inch) minimum thickness and 6 mm (1/4-inch) minimum thickness at beveled edge.
 - 5. Set not more than 13 mm (1/2-inch) above adjoining finished floor surfaces, with transition edges beveled on a slope of no greater than 1:2. On existing floor slabs provide 13 mm (1/2-inch) above ceramic tile surface with bevel edge joint top flush with adjacent floor.
 - 6. One piece full width of door opening. Notch thresholds to match profile of door jambs.

2.10 METAL DIVIDER STRIPS

- A. Terrazzo type divider strips.
- B. Heavy top type strip with 5 mm (3/16 inch) wide top and 38 mm (1-1/2 inch) long leg.
- C. Embedded leg perforated and deformed for keying to mortar.
- D. Aluminum or brass as specified in Section 09 06 00, SCHEDULE FOR FINISHES.

2.11 WATER

Clean, potable and free from salts and other injurious elements to mortar and grout materials.

2.12 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.

2.13 FLOOR MORTAR BED REINFORCING

ASTM A185 welded wire fabric without backing, MW3 x MW3 (2 x 2-W0.5 x W0.5).

2.14 POLYETHYLENE SHEET

- A. Polyethylene sheet conforming to ASTM D4397.
- B. Nominal thickness: 0.15 mm (six mils).
- C. Use sheet width to minimize joints.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperature of work areas at not less than 16 degree C (60 degrees F), without interruption, for not less than 24 hours before installation and not less than three days after installation.
- B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation and ANSI Specifications for installation.
- C. Do not install tile when the temperature is above 38 degrees C (100 degrees F).
- D. Do not install materials when the temperature of the substrate is below 16 degrees C (60 degrees F).
- E. Do not allow temperature to fall below 10 degrees C (50 degrees F) after fourth day of completion of tile work.

3.2 ALLOWABLE TOLERANCE

- A. Variation in plane of sub-floor, including concrete fills leveling compounds and mortar beds:
 - 1. Not more than 1 in 500 (1/4 inch in 10 feet) from required elevation where Portland cement mortar setting bed is used.
 - 2. Not more than 1 in 1000 (1/8 inch in 10 feet) where dry-set Portland cement, and latex-Portland cement mortar setting beds and chemical-resistant bond coats are used.
- B. Variation in Plane of Wall Surfaces:
 - 1. Not more than 1 in 400 (1/4 inch in eight feet) from required plane where Portland cement mortar setting bed is used.
 - 2. Not more than 1 in 800 (1/8 inch in eight 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 in 200 (1/16 inch per foot).
 - 3. Allow not less than 50 mm (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 seven days. Do not use curing compounds or coatings.
- D. Additional preparation of concrete floors for tile set with epoxy, or furan-resin shall be in accordance with the manufacturer's printed instructions.

E. 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.

F. 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.
4. Apply metal lath to framing in accordance with ANSI A108.1:
 - a. Use fasteners specified in paragraph "Fasteners." Use washers when lath opening is larger than screw head.
 - b. Apply scratch and leveling coats to metal lath in accordance with ANSI A108.1.C.
 - c. Total thickness of scratch and leveling coats:
 - 1) Apply 9 mm to 16 mm (3/8 inch to 5/8 inch) thick over solid backing.
 - 2) 16 mm to 19 mm (5/8 to 3/4 inch) thick on metal lath over studs.
 - 3) Where wainscots are required to finish flush with wall surface above, adjust thickness required for flush finish.
 - d. Apply scratch and leveling coats more than 19 mm (3/4 inch) thick in two coats.

G. 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 A108.11 except as specified otherwise.
- C. Install units horizontally or vertically to minimize joints with end joints over framing members. Units with rounded edges; face rounded edge away from studs to form a V joint for joint treatment.
- D. Secure cementitious backer units to each framing member with screws spaced not more than 200 mm (eight inches) on center and not closer than 13 mm (1/2 inch) from the edge of the backer unit or as recommended by backer unit manufacturer. Install screws so that the screw heads are flush with the surface of the backer unit.
- E. Where backer unit joins shower pans or waterproofing, lap backer unit over turned up waterproof system. Install fasteners only through top one-inch of turned up waterproof systems.
- F. Do not install joint treatment for seven days after installation of cementitious backer unit.
- G. Joint Treatment:
 - 1. Fill horizontal and vertical joints and corners with latex-Portland cement mortar. Apply fiberglass tape over joints and corners and embed with same mortar.
 - 2. Leave 6 mm (1/4 inch) space for sealant at lips of tubs, sinks, or other plumbing receptors.

3.5 GLASS MAT WATER-RESISTANT GYPSUM BACKER BOARD

- A. Install in accordance with manufacturer's instructions. TCA Systems W245-01.
- B. Treat joints with tape and latex-Portland cement mortar or adhesive.

3.6 MARBLE

- A. Secure thresholds and stools in position with minimum of two stainless steel dowels.
- B. Set in dry-set Portland cement mortar or latex-Portland cement mortar bond coat.
- C. Set threshold to finish 12mm (1/2 inch) above ceramic tile floor unless shown otherwise, with bevel edge joint top flush with adjacent floor similar to TCA detail TR611-02.

3.7 METAL DIVIDER STRIPS

- A. Install metal divider strips in floor joints between ceramic and quarry tile floors and between tile floors and adjacent flooring

of other materials where the finish floors are flush unless shown otherwise.

- B. Set divider strip in mortar bed to line and level centered under doors or in openings.

3.8 CERAMIC TILE - GENERAL

- A. Comply with ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" applicable to methods of installation.
- B. Comply with TCA Installation Guidelines:
- C. Installing Mortar Beds for Floors:
 - 1. Install mortar bed to not damage cleavage or waterproof membrane; 32 mm (1-1/2 inch) minimum thickness.
 - 2. Install floor mortar bed reinforcing centered in mortar fill.
 - 3. Screed finish to level plane or slope to drains where shown, float finish.
 - 4. For thin set systems cure mortar bed not less than seven days. Do not use curing compounds or coatings.
 - 5. For tile set with Portland cement paste over plastic mortar bed coordinate to set tile before mortar bed sets.
- D. Setting Beds or Bond Coats:
 - 1. Where recessed or depressed floor slabs are filled with Portland cement mortar bed, set ceramic mosaic floor tile in either Portland cement paste over plastic mortar bed or latex-Portland cement mortar over cured mortar bed except as specified otherwise, ANSI A108-1C, TCA System F121-02 or F111-02.
 - 2. Use quarry tile in chemical-resistant bond coat, except in floor of walk-in refrigerator rooms use: TCA system R 612-02.
 - a. Portland cement paste over plastic mortar bed. ANSI A108.1A.
 - b. Dry-set Portland cement mortar over cured mortar bed. ANSI A108.1B.
 - 3. Set floor tile in elastomeric bond coat over elastomeric membrane ANSI 108. 13, TCA System F122.
 - 4. 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.
 - 5. Set wall tile installed over concrete backer board in latex-Portland cement mortar, ANSI A108.1B.
 - 6. Set wall tile installed over Portland cement mortar bed on metal lath base in Portland cement paste over plastic mortar

bed, or dry-set Portland cement mortar or latex-Portland cement mortar over a cured mortar bed, ANSI A108.1C, TCA System W231-02, W241-02.

7. Set tile over concrete in therapeutic pools in Portland cement paste or dry set Portland cement mortar, ANSI A108.1C, TCA System S151-02
8. Set tile installed over gypsum board and gypsum plaster in organic adhesive, ANSI A108.4, TCA System W242-02.
9. 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 200 mm (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 reveals of openings with tile, except where other finish materials are shown or specified.
- c. At window openings, provide tile stools and reveals, except where other finish materials are shown or specified.
- d. 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 2 mm (1/16 inch) wide for glazed wall tile and mosaic tile work.
- c. Make joints in quarry tile work not less than 6 mm (1/4 inch) nor more than 9 mm (3/8 inch) wide. Finish joints flush with surface of tile.
- d. Make joints in Paver tile, porcelain type; maximum 3 mm (1/8 inch) wide.

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, tub enclosures, laundries and swimming pools.
- b. Tile installed with chemical-resistant mortars and grouts.
- c. Tile wall installations composed of tiles 200 by 200 mm (8 by 8 inches or larger).
- d. Exterior tile wall installations.

3.9 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 in 100 (1/8 inch per foot).

3.10 PORCELAIN TILE INSTALLED WITH LATEX PORTLAND CEMENT BONDING MORTAR

Due to the denseness of porcelain tile use latex Portland cement bonding mortar that meets the requirements of ANSI A118.4. 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.

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

- A. Installation of Tile: ANSI A108.5, except as specified otherwise.
- B. Slope tile work to drains not less than 1 in 100 (1/8 inch per foot).

3.12 THIN SET CERAMIC AND PORCELAIN TILE INSTALLED WITH ORGANIC ADHESIVE

Installation of Tile: ANSI A108.4.

3.13 THIN SET CERAMIC AND PORCELAIN TILE INSTALLED WITH CHEMICAL-RESISTANT BOND COAT

- A. Epoxy Resin Type: Install tile in accordance with Installation of Tile with Epoxy Mortar; ANSI A108.6.
- B. Furan Resin Type: Proportion, mix and place in accordance with the manufacturer's printed instructions. Set tile in accordance with ANSI A108.8.

3.14 CERAMIC AND PORCELAIN TILE INSTALLED WITH ELASTOMERIC BOND COAT

- A. Surface Preparation: Prepare surfaces as specified in paragraph 3.3G
- B. Installation of Elastomeric Membrane: ANSI A108.13 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 0.75 to 1.3 mm (30 to 50 mils).
 - 3. Extend material over flashing rings of drains and turn up vertical surfaces not less than 100 mm (four 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 1.3 to 1.9 mm (50 to 75 mils).
 - 5. After curing test for leaks with 25 mm (one 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 of aggregate surfacing specified in ASTM C1127. Do not install top coat over tile.

3.15 GROUTING

- A. Workmanship:
 1. Install and cure grout in accordance with the applicable standard.
 2. Portland Cement grout: ANSI A108.10.
 3. Epoxy Grout: ANSI A108.6.
 4. Furan and Commercial Portland Cement Grout: ANSI A108.8 and in accordance with the manufacturer's printed instructions.
 5. Dry-set grout: ANSI A108.5.

3.16 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.

3.17 CLEANING

- A. Thoroughly sponge and wash tile. Polish glazed surfaces with clean dry cloths.
- B. Methods and materials used shall not damage or impair appearance of tile surfaces.
- C. The use of acid or acid cleaners on glazed tile surfaces is prohibited.
- D. Clean tile grouted with epoxy, furan and commercial Portland cement grout and tile set in elastomeric bond coat as recommended by the manufacturer of the grout and bond coat.

3.18 PROTECTION

- A. Keep traffic off tile floor, until grout and setting material is firmly set and cured.
- B. Where traffic occurs over tile floor, cover tile floor with not less than 9 mm (3/8 inch) thick plywood, wood particle board, or hardboard securely taped in place. Do not remove protective cover until time for final inspection. Clean tile of any tape, adhesive and stains.

3.19 TESTING FINISH FLOOR

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

B. Test kitchen and storage rooms.

- - - E N D - - -

SECTION 09 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: Section 09 06 00, SCHEDULE FOR FINISHES. Also refer to the finish schedule displayed on the drawings.

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
 - 3. Runners designed for snap-in attachment of metal pans.
- 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.
 - b. Extruded aluminum.
 - c. Fire resistant plastic (glass fiber) having a flame spread and smoke developed rating of not more than 25 when tested in accordance with ASTM E84.
 - 2. Use same construction for cross runners as main runners. Use of lighter-duty sections for cross runners is not acceptable.
 - 3. Use aluminum suspension in kitchens and aluminum or fire resistant plastic in toilets adjacent to shower areas, hydrotherapy, and swimming pools.
- B. Exposed grid suspension system for support of lay-in panels:
 - 1. Exposed grid width not less than 22 mm (7/8 inch) with not less than 8 mm (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 specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Concealed grid suspension system for support of mineral base acoustical tile:
1. Concealed grid upward access suspension system to provide an initial opening of 300 mm by 600 mm (12 by 24 inches) and for removal of adjacent runners and tile without the use of special tools, and without damage to suspension system and acoustical tile.
 2. Minimum flange width of 22 mm (7/8 inch) except for access hook and angle.
 3. Minimum flange width of 11 mm (7/16 inch) for access hook and angle.
- D. Suspension system for support of Metal Type V, VI, and VII tiles: Concealed grid type having runners designed for the snap-in attachment of metal tile (pans).

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 9 mm (3/8 inch) wide strip.

2.3 WIRE

- A. ASTM A641.
- B. For wire hangers: Minimum diameter 2.68 mm (0.1055 inch).
- C. For bracing wires: Minimum diameter 3.43 mm (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:
 1. Fabricate inserts from steel, zinc-coated (galvanized after fabrication).
 2. Nailing type option for wood forms:
 - a. Upper portion designed for anchorage in concrete and positioning lower portion below surface of concrete approximately 25 mm (one inch).

- b. Lower portion provided with not less than 8 mm (5/16 inch) hole to permit attachment of hangers.
 - 3. Flush ceiling insert type:
 - a. Designed to provide a shell covered opening over a wire loop to permit attachment of hangers and keep concrete out of insert recess.
 - b. Insert opening inside shell approximately 16 mm (5/8 inch) wide by 9 mm (3/8 inch) high over top of wire.
 - c. Wire 5 mm (3/16 inch) diameter with length to provide positive hooked anchorage in concrete.
- 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.
- D. Tile Splines: ASTM C635.

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 300 m (per thousand linear feet):

Size mm	Size Inches	Cold-rolled		Hot-rolled	
		Kg	Pound	Kg	Pound
38	1 1/2	215.4	475	508	1120
50	2	267.6	590	571.5	1260

2.6 ADHESIVE

- A. ASTM D1779, having flame spread index of 25 or less when tested in accordance with ASTM E84.
- B. Developing minimum strength of 7 kg/m² (one psi) of contact surface 48 hours after installation in temperature of 21 °C (70 °F).

2.7 ACOUSTICAL UNITS

- A. General:
 - 1. Ceiling Tile shall meet minimum 37% bio-based content in accordance with USDA Bio-Preferred Product requirements.

2. ASTM E1264, weighing 3.6 kg/m² (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): 40-44 range unless specified otherwise: ASTM E413.
6. Manufacturers standard finish, minimum Light Reflectance (LR) coefficient of 0.75 on the exposed surfaces, except as specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES. Colored units integrally colored throughout.
7. Lay-in panels: Sizes as shown, with square edges reveal edges, tegular, or as indicated on the drawings.
8. Tile for concealed grid upward access system: Optional 300 by 300 or 300 by 600 mm (12 by 12 or 12 by 24 inch) size.
 - a. Cross score 300 by 600 mm (12 by 24 inch) tile to simulate 300 by 300 mm (12 by 12 inch) tile edges.
 - b. Provide tile with beveled or square edges and joints as required to suit suspension and access system.
- B. Type III Units - Mineral base with water-based painted finish less than 10 g/l VOC, Form 2 - Water felted, minimum 16 mm (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 16 mm (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 V Units - Perforated steel facing (pan) with mineral or glass fiber base backing.
 1. Steel ASTM A653, not less than 0.38 mm (0.015 inch) thick, minimum G30 galvanizing.
 2. Bonderize both sides of sheet and apply two coats of baked-on enamel finish, free from gloss or sheen, on surfaces exposed to view and at least one coat on concealed surfaces.

2.9 ACCESS IDENTIFICATION

- A. Markers:
 1. Use colored markers with pressure sensitive adhesive on one side.
 2. Make colored markers of paper or plastic, 6 to 9 mm (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 600 mm (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 1.48 m² (16 sf) 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 one 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 100 mm (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 1200 mm (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. Concrete:
 - a. Install hanger inserts and wire loops required for support of hanger and bracing wire in concrete forms before concrete is placed. Install hanger wires with looped ends through steel deck if steel deck does not have attachment device.
 - b. Use eye pins or threaded studs with screw-on eyes in existing or already placed concrete structures to support hanger and bracing wire. Install in sides of concrete beams or joists at mid height.
2. 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 ensure that the maximum deflection specified will not be exceeded.
 - 2) Attach hangers to steel carrying channels, spaced four 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 1200 mm (4 feet) on center before fire proofing 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.

B. 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, 1200 mm (4 feet) on centers unless interference occurs by mechanical systems. Use indirect hung suspension system where not possible to maintain hanger spacing.

C. Indirect Hung Suspension System:

- 1. As illustrated in ASTM C635.
- 2. Space carrying channels for indirect hung suspension system not more than 1200 mm (4 feet) on center. Space hangers for carrying channels not more than 2400 mm (8 feet) on center or for carrying channels less than 1200 mm (4 feet) on center so as to ensure that specified requirements are not exceeded.
- 3. Support main runners by specially designed clips attached to carrying channels.

D. Seismic Ceiling Bracing System: Conform to California Building Code (CBC) Seismic Zone 4.

- 1. Construct system in accordance with ASTM E580.
- 2. Connect bracing wires to structure above as specified for anchorage to structure and to main runner or carrying channels of suspended ceiling at bottom.

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 6 mm (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. Tile in concealed grid upward access suspension system:
 - 1. Install acoustical tile with joints close, straight and true to line, and with exposed surfaces level and flush at joints.

2. Make corners and arises full, and without worn or broken places.
 3. Locate acoustical units providing access as specified under Article, ACCESS.
- D. 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. Attach marker on exposed ceiling surface of upward access acoustical unit.

3.5 CLEAN-UP AND COMPLETION

- A. Replace damaged, discolored, dirty, cracked and broken acoustical units.
- B. Leave finished work free from defects.

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SECTION 09 51 20

WOOD GRILLE CEILING PANELS AND SUSPENSION SYSTEMS

PART 1- GENERAL

1.1 SUMMARY

- A. Furnish and install wood grille ceiling panels and metal suspension system as indicated on the drawings and specified, including the following:
 - 1. Concealed suspension system for wood grille ceiling panels.
 - 2. Wood grille ceiling panels for concealed suspension system.
 - 3. Trim and accessories.
 - 4. Seismic restraints for suspended ceiling system.

1.2 RELATED WORK

- A. Color, pattern, and location of each type of ceiling unit: Section 09 06 00, SCHEDULE FOR FINISHES. Also refer to the finish schedule displayed on the drawings.

1.3 SUBMITTAL

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

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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

1.6 SHOP DRAWINGS & COORDINATION WITH OTHER TRADES

- A. Shop Drawings: Provide Shop Drawings and Coordination Drawings for all ceilings, which should include Reflected Ceiling Plans (RCP) and product details. Coordinate wood grille ceiling panels layout and installation of wood panels and suspension system components with other construction elements that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, partition assemblies and all perimeter conditions.

1.7 PROJECT CONDITIONS

- A. Space Enclosure and Environmental Limitations: Do not install wood panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is completed and dry, work above ceilings is complete, and ambient temperature and humidity conditions are being maintained at the levels indicated for Project when occupied for its intended use.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Unloading: Coordinate crate sizes, weights, unloading options, and delivery schedule with manufacturer prior to fabrication. Deliver wood panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other mistreatment.

- B. Acclimatization: Before installing wood panels, permit them to reach room temperature and a stabilized moisture content (at least 72 hours) per American Woodwork Institute (AWI) standards.
- C. Handling: Handle Wood Grille ceiling panels carefully to avoid chipping edges or damaging units in any way.
- D. Protection:
 - 1. Personnel: Follow good safety and industrial hygiene practices during handling and installing of all products and systems, with personnel to take necessary precautions and wear appropriate protective equipment as needed. Read related literature for important information on products before installation. Contractor to be solely responsible for all personal safety issues during and subsequent to installation; Architect, Contracting Officer, and manufacturer will rely on Contractor's performance in such regard.
 - 2. Existing completed work: Protect completed work above suspension system from damage during installation of suspension system components.

1.9 WARRANTIES

- A. Warranties: Provide Government with warranties for material and workmanship on all installed products.
 - 1. Manufacturers: All materials, wood ceiling and grid, shall be warranted for 5 years for material and workmanship.
 - 2. Installer: All work shall be warranted for one year from final acceptance of completed work.

1.10 ON-SITE MOCKUPS

- A. Build mockups at the site of the work to verify selections made by the Architect and to demonstrate aesthetic effects and qualities of materials and execution.
- B. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 WOOD GRILLE CEILING PANELS AND METAL SUSPENSION SYSTEM (WGCPMSS)

- A. Subject to compliance with specified requirements, WGCPMSS shall be 9Wood, Inc. (www.9wood.com): 1100 Cross Piece Backer, or an "or equal" product of one of the following:
- B. Other Acceptable Manufacturers: Subject to review of product data and samples, ceiling systems by the following manufacturers may also be deemed acceptable:
 - 1. Rulon Company
 - 2. Ceiling Plus
- C. Basis of Design: 9Wood, Inc. Wood Grille, Series 1000
 - 1. Wood Panels: 9Wood EcoGrille

- a. Species: FSC Hemlock
- b. Member Size: 5/8" x 1 1/8"
- c. Edge Profile: Square
- d. Members/LF: As standard with the manufacturer
- e. Assembly Style: Cross Piece Backer
- f. Panel Sizes: As selected by the Architect
- g. Fire Rating: Fire Rating Class, Class 1(A) Fire Rating
- h. Finish: As selected by the Architect
- i. Reveal Scrim: Black reveal scrim

2.2 METAL SUSPENSION SYSTEMS

- A. Metal T-Grid Suspension System: Provide standard interior Metal Heavy Duty suspension T-Grid system using Main Runners, Cross-tees, Wall Angle or Shadow Moldings of types, structural classifications, and <black> finishes indicated and that comply with applicable ASTM C 635 requirements. Comply with all applicable <seismic> codes and ordinances.
- B. Attachment Devices: Size for 3 times the design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire, Braces, Ties, Hanger Rods, Flat Hangers and Angle Hangers: Provide wires, rods and hangers that comply with applicable ASTM specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine substrates and structural framing to which ceilings attach or abut, with installer present, for compliance with requirements specified in this and other sections that affect ceiling installation and anchorage. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
- B. Layout: Measure each ceiling area and establish the layout of Wood Grille Panel to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and conform to the layout shown on reflected ceiling plans in accordance with wood ceiling manufacturer's approved Shop Drawings.

3.3 INSTALLATION

- A. General: Install WGCPMSS to comply with manufacturer's instructions and CISCA "Ceiling Systems Handbook."

- B. Attachments: Suspend ceiling hangers from building's structural members per manufacturer's instructions and in compliance with all local codes and regulations.
- C. Installation of Metal T-Bar Grid: Install, align, brace, tie-off, mount, handle interferences, and space suspension T-Grid in accordance with suspension manufacturer's instructions and in compliance with all local codes and regulations.
- D. Install with undamaged edges and fitted accurately to suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit, as required.
- E. Suspension Runners: Install suspension system runners so they are square and securely interlocked with one another. Install number and use on-center spacing per wood ceiling manufacturer's instructions, as indicated on approved Shop Drawings and in compliance with all local codes.

3.4 CLEANING

- A. Clean exposed wood surfaces of WGCPMSS to comply with manufacturer's instructions for cleaning and touchup of minor finish damage. Remove and replace wood ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

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SECTION 09 54 66

WOOD GRAIN SUSPENDED CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install wood grain acoustical ceilings as indicated on the drawings and specified.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - 2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot- Dip Process.
 - 3. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - 6. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 7. ASTM E 580 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint.
 - 8. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
- B. International Code Council Evaluation Service
 - 1. AC156 - Acceptance Criteria for Seismic Qualification Testing of Non-structural Components

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.
- B. Installation Instructions: Submit manufacturer's installation instructions.
- C. Samples: Submit samples of specified panel; 8 inch long samples of exposed wall molding and suspension system.

- D. Shop Drawings: Submit manufacturer's dimensioned shop drawings.
- E. Mock-ups: A panel consisting of a single structural bay for each system shall be built in place for Architect review prior to proceeding with the rest of work.
- E. Certifications: Submit manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

1.4 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: Tested per ASTM E 84:
 - a. Flame Spread: 25 or less
- B. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.
- C. Seismic Performance: System seismic performance verified through full-scale testing in accordance with ICC-ES - AC-156 Acceptance Criteria for Seismic Qualification Testing of Non-Structural components.
 - 1. Comply with the California Building Code for Seismic Zone 4.
- D. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store ceiling components in a dry interior location in their cartons prior to installation to avoid damage. Store cartons in a flat, horizontal position. The protectors between the panels shall not be removed until installation.
- B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Panels shall not be exposed to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.
- C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.6 PROJECT CONDITIONS

- A. Wood grain ceiling materials shall be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize).
- B. The wood veneer panels shall not be installed in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.
- C. As interior finish products, the wood veneer panels shall be designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity shall not fall below 25 percent or exceed 55 percent.

1.7 WARRANTY

- A. Wood grain Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:
 - 1. Defects in materials or factory workmanship.
- B. Warranty Period:
 - 1. Wood Grain Panel System: Two years from date of installation.
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.
- D. Purpose and Limitations: This information and data are provided by the manufacturer to better describe the product(s) and/or subject installation, solely for further evaluation by the Specifier. The Manufacturer makes no representations, nor provides any warranty for the data provided except to the extent where it is applicable that it was prepared by an independent licensed professional engineer. This information is not provided in lieu of the separate and independent evaluation and determination of suitability of these materials for the subject installation that is the responsibility of the specifier of their agents.

1.8 MAINTENANCE MATERIALS

- A. For maintenance purposes, deliver extra materials to Owner. Furnish extra materials described below that match products installed, packaged with protective covering for storage and identified with appropriate labels.

1. Ceiling Units: Furnish quality of full-size units equal to 1.0 percent of quantity installed.
2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 1.0 percent of quantity installed.

PART 2 PRODUCTS

2.1 SUSPENSION SYSTEM

- A. Suspension system shall be the product of Armstrong World Industries, Inc., or "or equal" product of one of the following:
 1. USG
 2. BPB
- B. The suspension system shall be flat or curved as indicated on the drawings.
- C. Suspension Components: H-bar sections shall be commercial-quality extruded aluminum. Exposed surfaces chemically cleansed. H-bars shall be suspended from BPM300.100 U-profile carrying channel.
- D. Finish: All steel parts shall be chemically cleansed hot dipped galvanized steel.
 1. Wall Molding Color: To be selected from manufacturer's standard offering.
- E. Hanger Wire: Hanger wire shall be galvanized carbon steel per ASTM A 641, soft temper, pre-stretched, with a yield stress load of at least three (3) times design load, but not less than 12 gauge (0.106") diameter.

2.2 WOOD GRAIN CEILING UNITS

- A. Subject to compliance with specified requirements, ceiling units shall be by the manufacturer indicated on the drawings or an "or equal" product by Armstrong, or an "or equal" product by one of the following:
 1. USG
 2. BPB Celotex
 3. Armstrong
- B. Wood Panels:
 1. Plenum Access: Full downward access.
 2. Size: According to the drawings
 3. Surface Finish: Grade: Premium
 4. Flame Spread: Class A per CBC or UL.

C. Accessories:

1. Cutouts and apertures shall be provided as directed by the Architect.
2. Edge Banding for field-modified panels: Pre-finished pressure sensitive adhesive banding is available 15/16 inch wide and in 50 foot lengths. Veneers shall match the panels.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, drywall, plastering and painting has been completed and thoroughly dried out.
- B. Proper design for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.2 PREPARATION

- A. Examine construction and conditions under which the system will be installed. Do not proceed with installation until unsatisfactory conditions have been corrected. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

- A. Install suspension system and wood panels in compliance with ASTM C636, with the requirements of authorities having jurisdiction, and in accordance with the manufacturer's shop drawings and installation instructions.

3.4 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

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SECTION 09 60 23

SCHLUTER (OR EQUAL) FINISH EDGINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install Schluter (or equal) flooring, wall, and base edgings as indicated on the drawings and specified.
- B. Shop Drawings: Show fabrication and installation of edgings. Include profiles, cross sections, component details, and attachments to other Work. Indicate materials and profiles of each metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

PART 2 - PRODUCTS

2.1 SCHLUTER (OR EQUAL) FINISH EDGINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by Schluter Systems, or equal.
- B. Base metals shall as indicated on the drawings or as selected by the Architect from the following (as selected by the Architect):
 - 1. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of extruded shapes: ASTM B 221, alloy 6063-T6.
 - 2. Stainless Steel: ASTM A 554, Grade MT 304.
 - 3. Solid Brass: ASTM B927.
- C. Fasteners: Use fasteners of same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
- D. Form edge profiles to required shapes and sizes, with true curves, lines, and angles. Provide components in sizes and profiles indicated, but not less than that needed to comply with requirements indicated for structural performance.
- E. Finishes shall be as selected by the Architect.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install edgings as recommended by the product manufacturer. Provide anchorage devices and fasteners where necessary for securing the item to in-place construction.

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SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the installation of resilient flooring, vinyl or rubber base.

1.2 RELATED WORK

- A. Color and texture: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Integral base with 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 and stair material manufacturer's recommendations for adhesives.
 - 3. Application and installation instructions.
- C. Samples:
 - 1. Base: 150 mm (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 publication 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):
F1861-02..... Resilient Wall Base

PART 2 - PRODUCTS

2.1 GENERAL

- A. Subject to compliance with specified requirements, topset rubber base shall be by Johnsonite or equal. Refer to finish schedule on Architectural Drawings for style and color designation.
- B. Use only products by the same manufacturer and from the same production run.

2.2 RESILIENT BASE

- A. ASTM F1861, 3 mm (1/8 inch) thick, 100 mm (4 inches) high, Type TP Rubber, Thermoplastics, Group 2-layered with molded top. Style B-cove.
- B. Where carpet occurs, use Style A-straight.
- C. Use only one type of base throughout.

2.3 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 21° C (70 °F), for 48 hours before installation.
- B. Maintain temperature of rooms where work occurs, between 21° C and 27° C (70°F and 80°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 Resident Engineer.
- B. Submit proposed installation deviation from this specification to the Resident Engineer indicating the differences in the method of installation.

- C. The Resident Engineer 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 3 mm (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 and stair treads 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 600 mm (24 inches) 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 STAIR TREAD INSTALLATION

- A. Prepare surfaces to receive the treads in accordance with applicable portions of paragraph, preparation.
- B. Layout of Treads.
 1. No joints will be accepted in treads.,
 2. Set full treads on intermediate and floor landings.
- C. Application:
 1. Apply adhesive uniformly with no bare spots.
 2. Roll and pound treads to assure adhesion.

3.6 SHEET RUBBER INSTALLATION.

- A. Prepare surfaces to receive sheet rubber in accordance with applicable portions of paragraph, preparation.
- B. Layout of Sheet Rubber:
 1. Use minimum number of joints compatible with material direction and symmetrical joint location.
 2. Where sheet rubber intersect vertical stair members, other sheets, stair treads, and other resilient materials at the floor landings, material shall touch for the entire length within 5 mils (0.005 inch).
 3. Install sheet rubber on floors and intermediate landings where resilient stair treads are installed; center joint with other flooring material under doors.
- C. Application:
 1. Apply adhesive uniformly with no bare spots.
 2. Roll sheet rubber to assure adhesion.

3.7 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 two weeks, scrub resilient base, sheet rubber and treads materials 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.

2. Do not polish tread and sheet rubber materials.
- D. When construction traffic is anticipated, cover tread materials with reinforced kraft paper and plywood or hardboard properly secured and maintained until removal is directed by the Resident Engineer.
- E. 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 and integral cove base, including rubber flooring.
- B. Installation of sheet flooring including following:
 - 1. Heat welded seams.
 - 2. Integral cove base: Installed at intersection of floor and vertical surfaces.

1.2 RELATED WORK

- A. Color, pattern and texture: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Resilient base required over metal base of casework: Section 12 31 00, MANUFACTURED METAL CASEWORK.
- C. Resilient base over base of lockers, equipment and casework: 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 three installations similar and equivalent in size to this project for three 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 (VOC's).

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, 38 mm by 300 mm (1-1/2 inch by 12 inch), of each color and pattern with a welded seam using proposed welding rod.
 - 2. Cap strip and fillet strip, 300 mm (12 inches) for integral base.
 - 3. 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.
 - 4. Certificates: Quality Control Certificate Submittals and lists specified in paragraph, QUALIFICATIONS.
 - 5. Edge strips: 150 mm (6 inches) long each type.
 - 6. Adhesive, underlayment and primer: Pint container, each type.

1.5 PROJECT CONDITIONS

- A. Maintain temperature of floor materials and room, where work occurs, above 18 ° C (65 °F) and below 38 °C (100 °F) for 48 hours before, during and for 48 hours after installation. After above period, room temperature shall not fall below 13 °C (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 extent referenced. Publications are referenced in text by basic designation only.
- B. American Society For Testing Materials (ASTM):
 - E648-06.....Critical Radiant Flux of Floor-Covering Systems Using a Radiant Energy Source.
 - E662-06.....Specific Optical Density of Smoke Generated by Solid Materials.
 - E1907-06.....Evaluating Moisture Conditions of Concrete Floors to Receive Resilient Floor Coverings
 - F710-05.....Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.
 - F1303-04.....Sheet Vinyl Floor Covering with Backing.
 - F1913-04.....Sheet Vinyl Flooring without Backing
- C. Resilient Floor Covering Institute (RFCI): Recommended Work Practices for Removal of Resilient Floor Coverings.

1.8 SCHEDULING

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:

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

PART 2 - PRODUCTS

2.1 SHEET VINYL FLOOR COVERINGS

- A. Subject to compliance with specified requirements, provide the vinyl sheet flooring by Johnsonite, or equal products of one of the followings:
 - 1. Azrock Floor Products Inc.
 - 2. Tarkett Inc.
 - 3. Mannington Mills Inc.
 - 4. Armstrong.
- B. Sheet Vinyl Floor Coverings: Smooth face, minimum thickness nominal 2 mm (0.08 inch). 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.
- C. Size: Provide maximum size sheet vinyl material produced by manufacturer to provide minimum number of joints. Minimum size width acceptable - 1200 mm (48 inches).
- D. Each color and pattern of sheet flooring shall be of same production run.

2.2 WELDING ROD:

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.
- C. Base Accessories:
 - 1. Fillet Strip: 19 mm (3/4 inch) radius fillet strip compatible with resilient sheet material.
 - 2. Cap Strip: Extruded flanged zero edge vinyl reducer strip approximately 25 mm (one inch) exposed height with 13 mm (1/2 inch) flange.

2.4 SHEET RUBBER FLOORING

- A. manufacturer: Subject to compliance with specified requirements, provide products of Mondo USA, or an "or equal" products of one of the following (or equal):

1. Burke Flooring Products Div., Burke Industries, Inc.
 2. Dodge-Regupol Inc.
 3. Musson Rubber Co.
 4. Pirelli Industrial Products Corp.
- B. ASTM F1344, F1860, not less than 3 mm (1/8 inch) thick, smooth face, color and pattern as selected by the Architect.
- C. Use rubber flooring made with a minimum of 90% consumer rubber where possible.

2.5 ADHESIVES

Water resistant type recommended by the sheet flooring manufacturer for the conditions of use.

2.6 BASE CAP STRIP AND COVE STRIP

- A. Extruded vinyl compatible with the sheet flooring.
- B. Cap strip "J" shape with feathered edge flange approximately 25 mm (one inch) wide; top designed to receive sheet flooring with 13 mm (1/2 inch) flange lapping top of flooring
- C. Cove strip 70 mm (2-3/4 inch) radius.

2.7 LEVELING COMPOUND (FOR CONCRETE FLOORS)

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

2.8 PRIMER (FOR CONCRETE SUBFLOORS)

As recommended by the adhesive or sheet flooring manufacturer.

2.9 EDGE STRIPS

- A. Extruded aluminum, mill finish, mechanically cleaned.
- B. 28 mm (1-1/8 inch) wide, 6 mm (1/4 inch) thick, bevel one edge to 3 mm (1/8 inch) thick.
- C. Drill and countersink edge strips for flat head screws. Space holes near ends and approximately 225 mm (9 inches) on center in between.

2.10 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 36 °C (65 °F), for 48 hours before installation.

- B. Maintain temperature of rooms where sheet flooring work occurs above 36 °C (65 °F), for 48 hours, before installation and during installation.
- C. After installation, maintain temperature at or above 36 °C (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. Concrete Subfloor Testing:
Determine adhesion and dryness of the floor by bond and moisture tests as recommended by RFCI manual MPR.
- 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 150 mm (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 Resident Engineer 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 aluminum strips in adhesive, anchor with lead anchors and stainless steel Phillips screws.

M. Integral Cove Base Installation:

1. Set preformed fillet strip to receive base.
2. Install the base with adhesive, terminate exposed edge with the cap strip.
3. Form internal and external corners to the geometric shape generated by the cove at either straight or radius corners.
4. Solvent weld joints as specified for the flooring. Seal cap strip to wall with an adhesive type sealant.
5. Unless otherwise specified or shown where sheet flooring is scheduled, provide integral base at intersection of floor and vertical surfaces. Provide sheet flooring and base scheduled for room on floors and walls under and behind areas where casework, laboratory and pharmacy furniture and other equipment occurs, except where mounted in wall recesses.

3.4 INSTALLATION OF INTEGRAL COVED BASE

- A. Set preformed cove to receive base. Install base material with adhesive and terminate exposed edge with cap strip.
- B. Internal and external corners shall be formed to geometric shape generated by cove at either square or radius corners.

3.5 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.

3.6 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 and polish 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, Resident Engineer 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.

3.7 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, re-clean sheet flooring, lightly re-apply polish and buff floor.

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SECTION 09 65 19

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the installation of vinyl tile flooring, vinyl composition tile flooring, rubber tile flooring, and accessories.

1.2 RELATED WORK

- A. Color and pattern and location in room finish schedule: Refer to Drawings.
- B. Resilient Base: Refer to Drawings.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS.
- B. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - 2. Resilient material manufacturer's recommendations for adhesives, underlayment, primers and polish.
 - 3. Application and installation instructions.
- C. Samples:
 - 1. Tile: 300 mm by 300 mm (12 inches by 12 inches) for each type, pattern and color.
 - 2. Edge Strips: 150 mm (Six inches) long, each type.
 - 3. Feature Strips: 150 mm (Six inches) long.
- D. Shop Drawings:
 - 1. Layout of patterns shown on the drawings.
 - 2. Edge strip locations showing types and detail cross sections.
- E. Test Reports:
 - 1. Abrasion resistance: Depth of wear for each tile type and color and volume loss of tile, certified by independent laboratory.
 - 2. Tested per ASTM F510.

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 weathertight and dry storage facility.
- B. Protect from damage from handling, water, and temperature.

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):
 - D4078-87.....Water Emulsion Floor Finish
 - D3564-88.....Application of Floor Polishes to Maintain Vinyl Asbestos Tile or Flooring
 - F510-81.....Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with a Grit Feed Method
 - F710-92.....Preparing Concrete Floors and other Monolithic Floors to Receive Resilient Flooring
 - F1066-87.....Vinyl Composition Floor Tile
 - F1344-91.....Rubber Floor Tile
- C. Federal Specifications (Fed. Spec):
 - SS-T-312B.....Tile, Floor: Asphalt, Rubber, Vinyl, and Vinyl
 - INT AMD 2.....Composition
 - MMM-A-115C-79.....Adhesive, Asphalt, Water Emulsion Type (For Asphalt And Vinyl Composition Tiles)
- D. National Fire Protection Association (NFPA):
 - NFPA 253-90.....Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using Radiant Heat Energy Source
- E. Resilient Floor Covering Institute (RFCI):
 - ADH-1.....Vinyl Composition Tile Adhesive
 - ID-2.....Concrete Treating Compounds Installation Specifications for Vinyl Composition, Solid Vinyl and Asphalt Tile Floorings
 - CL-1.....Cleaners for Use on Resilient Floor Coverings (Revised 1988)

TM-6.....Determination of Quality of Cut (Joint
Tightness and Corner Openings) of
Resilient Tile

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish product type, materials of the same production run.
- B. Use adhesives, underlayment, primers and polish recommended by the floor resilient material manufacturer.
- C. Interior Floor Finisher For Corridors, Stairs, and Halls: Class I, critical radiant flux minimum of 0.45 watts per square centimeter as determined by NFPA 253.
- D. Interior Floor Finishes For Remaining Areas: Class II, Critical radiant flux minimum of 0.22 watts per square centimeter as determined by NFPA 253.

2.2 VINYL COMPOSITION TILE

- A. ASTM F1066, Class 2, Type IV, Composition 1, non-asbestos, 300 mm (12 inches) square, 3.2 mm (1/8-inch) thick.
- B. Color and pattern uniformly distributed throughout thickness.

2.3 ADHESIVES

- A. Water emulsion asphalt: Fed. Spec. MMM-A-115.
- B. Latex type adhesives RFC ADH-1, Type III, Water based latex as recommended by tile manufacturer.
- C. Use only adhesive approved for flooring material applied to wood, plywood or particleboard underlayment.

2.4 PRIMER (FOR CONCRETE SUBFLOORS)

Asphaltic type as recommended by the adhesive and tile manufacturer.

2.5 LEVELING COMPOUND (For Concrete Floors)

- A. Provide products with latex or polyvinyl acetate resins in the mix.
- B. Determine the type of underlayment selected for use by the condition to be corrected.

2.6 POLISH AND CLEANERS

- A. Cleaners RFCI CL-1.
- B. Polish: ASTM D4078.

2.7 EDGE STRIPS

- A. 28 mm (1-1/8 inch) wide unless shown otherwise.
- B. Bevel from maximum thickness to minimum thickness for flush joint unless shown otherwise.

- C. Extruded aluminum, mill finish, mechanically cleaned.
 - 1. Drill and counter sink edge strip for flat head screws.
 - 2. Space holes near ends and approximately nine inches on center between.
- D. Resilient Edge Strip or Reducer Strip: Fed. Specs. SS-T-312, Solid vinyl.

2.8 SCREWS

Stainless steel flat head screw.

2.9 FEATURE STRIPS

- A. Use same material as floor tile.
- B. Sizes and shapes as shown.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

- A. Maintain temperature of materials a minimum of 22 degrees C (70 degrees F,) for 48 hours before installation.
- B. Maintain temperature of rooms where work occurs between 21 degrees and 27 degrees C 70 degrees and 80 degrees F, for at least 48 hours, before, during and after installation.
- C. Do not install flooring until building is permanently enclosed and wet construction in or near areas to receive tile materials is complete, dry and cured.

3.2 SUBFLOOR PREPARATION

- A. Examine surfaces on which resilient flooring is to be installed.
- B. Correct conditions which will impair proper installation.
- C. Fill cracks, joints and other irregularities in concrete with leveling compound and level floors for a maximum wave variation of 1:1000 (1/8-inch in 10 feet) (non-accumulative).
 - 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 joints.
- D. Clean floor of oil, paint, dust, and deleterious substances: Leave floor dry and cured free of residue from existing curing or cleaning agents.
- E. Concrete Subfloor Testing:
 - 1. Apply a 1 meter (three foot) square test patch to the prepared concrete subfloor in room or area to be tiled in accordance with RFCI ID-2.

2. After the test patches have remained on the floor for a period of 72 hours, check adherence to surface by scraping test patches for ease of removal in the presence of the Project Engineer.
3. In the event that test patch is easily removed the Project Engineer may require additional test patches as follows:
 - a. Area configuration such as long corridors or large rooms.
 - b. Slab conditions such as oil or fuel spillage which may have leached into the slab, and presence of questionable curing or release agents used on the slabs.
 - c. Retesting after additional subfloor preparation.
- F. Perform additional subfloor preparation to obtain satisfactory adherence of flooring if subfloor test patches allows easy remove of tile.
- G. Prime the concrete subfloor if the primer will seal slab conditions that would inhibit bonding, or if priming is recommended by the tile or adhesive manufacturers.

3.3 INSTALLATION

- A. Install in accordance with RFCI INS-87 and manufacturer's instructions for application and installation unless specified otherwise.
- B. Mix tile from at least two containers. An apparent line either of shades or pattern variance will not be accepted.
- C. Tile Layout:
 1. If layout is not shown on drawings, lay tile symmetrically about center of room or space with joints aligned.
 2. No tile shall be less than 6-inches and of equal width at walls.
 3. Place tile pattern in the same direction; do not alternate tiles.
- D. Trim tiles to touch for the length of intersections at pipes and vertical projections, seal joints at pipes with waterproof cement.
- E. Application:
 1. Apply adhesive uniformly with no bare spots.
 - a. Conform to RFCI-TM-6 for joint tightness and for corner intersection unless layout pattern shows random corner intersection.
 - b. More than 5 percent of the joints not touching or any joint more than 0.0051-inch wide will not be accepted.

2. Roll tile floor with a minimum 100 pound roller. No exceptions.
 3. The Project Engineer may have test tiles removed to check for non-uniform adhesion, spotty adhesive coverage, and ease of removal. Install new tile for broken removed tile.
- F. Installation of Edge Strips:
1. Locate edge strips under center line of doors unless otherwise shown.
 2. Set resilient edge strips in adhesive. Anchor metal edge strips with anchors and screws specified.
 3. Where tile edge is exposed, butt edge strip to touch along tile edge.
 4. Where thin set ceramic tile abuts resilient tile, set edge strip against floor file and against the ceramic tile edge.

3.4 CLEANING AND PROTECTION

- A. Clean adhesive marks on exposed surfaces during the application of resilient materials before the adhesive sets. Exposed adhesive is not acceptable.
- B. Keep traffic off resilient material 72 hours after installation.
- C. Clean and polish materials in the following order:
 1. For the first two weeks sweep and damp mopped only.
 2. After two weeks, scrub resilient materials with a minimum amount of water and a mild detergent. Leave surface clean and free of detergent residue.
 3. Apply polish to the floors in accordance with the polish manufacturer's instructions.
- D. When construction traffic occurs over tile, cover resilient materials with reinforced kraft paper properly secured and maintained until removal is directed by Project Engineer. At entrances and where wheeled vehicles or carts are used, cover tile with plywood, hardboard, or particle board over paper, secured and maintained until removal is directed by the Project Engineer.
- E. When protective materials are removed and immediately prior to acceptance, replace any damage tile, re-clean resilient materials, lightly re-apply polish and buff floors.

3.5 LOCATION

- A. Unless otherwise specified or shown, install tile flooring, on floor under areas where casework, laboratory and pharmacy furniture and other equipment occurs, except where mounted in wall recesses.
- B. Extend tile flooring for room into adjacent closets and alcoves.

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SECTION 09 66 45

SHEET RUBBER FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install sheet rubber flooring and accessories is shown on drawings and specified.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Provide sheet rubber flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.
- B. Installer's Qualifications: Engage Installer who is certified in writing by sheet rubber flooring manufacturer as qualified for installation of sheet rubber flooring.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for sheet rubber flooring and accessories.
- B. Samples: Submit the following samples of the sheet rubber flooring required, showing full-range of color and pattern variations.
 - 1. 6" x 9" samples of sheet flooring.
 - 2. 2-1/2 long samples of sheet rubber flooring accessories.
 - 3. Welding beads for sheet flooring.
- C. Maintenance Instructions: Submit 2 copies of manufacturer's recommended maintenance practices for each type of sheet rubber flooring and accessory required.

1.4 PROJECT CONDITIONS

- A. Maintain minimum temperature of 65 degrees F in spaces to receive sheet rubber flooring for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Store sheet rubber flooring materials in spaces where they will be installed for at least 48 hours before beginning installation.
- B. Install sheet rubber flooring and accessories after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 SHEET RUBBER FLOORING

- A. Manufacturer: Subject to compliance with specified requirements, provide the product indicated on the drawings, or an "or equal" product by one of the following:
 - 1. Pirelli Industrial Products Corporation
 - 2. Friedenburqc Building Systems.
 - 3. Dodge-Regupol Inc.
 - 4. Estrie Products Internationals
 - 5. Burke Rubber Corp.
- B. Sheet rubber flooring shall be as indicated on the drawings and have the following physical attributes:
 - 1. ASTM E84, Steiner Tunnel Fire Test:
 - a. Standard Formulation Designation: Class B.
 - b. Fire Resistant Formulation (min. req.) Designation: Class A.
 - 3. ASTM C501, Abrasion Resistance (H-18 Wheel, 1,000 Cycles): greater than 0.7.
 - 4. ASTM D2047, Static Coefficient of Friction: greater than 0.6.
 - 5. ASTM D2240, Hardness-Shore A: 87+5
 - 6. ASTM D412, Modulus: Exceed 300 psi.
 - 7. ASTM D412, Tensile Strength: Min. 900 psi.
 - 8. ASTM D412, Elongation: Min. 200%.
 - 9. ASTM D570, Water Absorption: Less than 0.3%.
 - 10. NBS Smoke Chamber, ASTM E662 and NFPA 2.58: 450 or less.

2.2 ACCESSORIES

- A. Resilient Edge Strips: 1/8" thick, homogeneous rubber or rubber composition, tapered or bullnose edge, color to match flooring, or as selected by Architect from standard colors available; not less than 1" wide.
- B. Adhesives (Cements): Waterproof, stabilized type as recommended by flooring manufacturer to suit material and substrate conditions.
- C. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.
- D. Leveling and Patching Compounds: Latex type as recommended by flooring manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Perform moisture condition test in each major area, minimum 1 per 1,000 square feet, prior to installation. Moisture condition shall not exceed 3 pounds per 1,000 square feet per 24 hour day, in accordance with ASTM F1869 or ASTM F2170, minimum 1 per 1,000 square feet prior to installation. Relative humidity shall not exceed 75%. Do not proceed with work until results of moisture condition tests are acceptable.
- B. Perform adhesive bond test in each major area, minimum 1 per 1,000 square feet, prior to installation. Examine after 72 hours to determine whether bond is solid and no moisture is present. Do not proceed with work until results of bond test are acceptable.
- C. Install sheet rubber flooring using method indicated in compliance with manufacturer's printed instructions. Extend sheet rubber flooring into toe spaces, door reveals, and into closets and similar openings.
 - 1. Comply with ASTM F2710.
- D. Scribe, cut, and fit sheet rubber flooring to permanent fixtures, built-in furniture and cabinets, pipes, outlets and permanent columns, walls and partitions.
- E. Tightly cement sheet rubber flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections. Hand roll sheet rubber flooring at perimeter of each covered area to assure adhesion.
- F. Clean sheet rubber flooring by method recommended by flooring manufacturer. Polish the sheet rubber flooring in a manner that is acceptable to the manufacturer of the flooring and as directed by the Owner's maintenance personnel.

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SECTION 09 67 10

GLAZED EPOXY WALL COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and apply glazed epoxy wall coatings as indicated on the drawings and specified.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data, installation instructions, and general recommendations for each resinous wall material required. Include certification indicating compliance of materials with requirements.
- B. For initial selection of colors and finishes, submit manufacturer's color charts showing full range of colors and finishes available.
- C. Samples: Submit, for verification purposes, 4-inch square samples of each type of resinous wall system required, applied to a rigid backing, in color and finish required.
- D. Certificates: Submit the following:
 - 1. Certifying that the coating complies with requirements of this specification, including resistance to abrasion and resistance to perspiration.
 - 2. Certifying that the coating supplied is the same, with the manufacturing tolerances, as the coating tested.

1.3 QUALITY ASSURANCE

- A. Manufacturer qualifications: Obtain primary resinous coating materials including waterproof membrane, osmotic pressure resistant grout (if required), crack treatment system, patching mortar, sealant, primers, aggregates, resins, hardening agents, and finish or sealing coats for both walls from a single manufacturer with not less than ten years of successful experience in manufacturing principal materials described in this section.
- B. Contractors Qualifications: Engage an experienced installer (applicator) with no less than 3 years experience, who has specialized in installing resinous floor or wall systems similar in material, design and extent to that indicated for this project and who is certified by the manufacturer as trained and approved by that same manufacturer. Provide a minimum of 3 references of projects of similar scope, design and materials.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Material shall be delivered to job site and checked by wall contractor for completeness and shipping damage prior to job start.

- B. All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.
- C. Material shall be stored in a dry, enclosed area protected from exposure to moisture. Temperature of storage area shall be maintained between 60 and 85oF/16 and 30oC.

1.5 PROJECT CONDITIONS

- A. Utilities, including electric, water, heat (air temperature between 60 and 85oF/16 and 30oC) and finished lighting to be supplied by the Contractor.
- B. Job area to be free of other trades during, and for a period of 24 hours, after wall installation.
- C. Protection of finished walls from damage by subsequent trades shall be the responsibility of the Contractor.

1.6 WARRANTY

- A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of 5 years from date of installation.
- B. The Installer shall furnish a 2-year labor warranty.

PART 2 - PRODUCTS

2.1 GLAZED EPOXY WALL COATINGS

- A. Subject to compliance with specified requirements glazed epoxy wall coatings shall be Stoneglaze VSI (10-12 mils) as manufactured by Stonhard Inc., or an "or equal" product of one of the following:
 - 1. Crossfield Products Corp.
 - 2. Mameco International, Inc.
 - 3. H.B. Fuller Co.
- B. Epoxy glaze wall system to be comprised of a three-component fiberglass reinforced epoxy base layer, and a three-component, high performance, high solids fiberglass reinforced epoxy glaze coating.
- C. Physical Properties: Provide wall system in which physical properties of topping when tested in accordance with standards or procedures referenced below, should be minimum as follows:
 - 1. Degree of Gloss (Semi Gloss) - Not less than 48 per ASTM D523
 - 2. V.O.C.70 grams/liter (ASTM D-2369)
 - 3. Hardness.....80-85 (ASTM D-2240/Shore D Durometer)
 - 4. Impact Resistance.....Exceeds 70 in. lbs. (ASTM D-2794).....(No cracking, crazing

-or loss of adhesion)
- 5. Abrasion Resistance..... .0.08 gm max. weight loss
(ASTM D-4060, Taber
Abrader CS-17 wheel)
 - 6. Fire Resistance of Dry Film. . . . Class A
(ASTM E84) Flame spread 10
Smoke developed 20
 - 7. Heat Resistance Limitation.....140oF/60oC
.....(for continuous
..... exposure)
..... 200oF/93oC
..... (for intermittent
spills)
 - 8. Cure Rate(at 77oF/25oC)..... .allow 24 hours for
..... normal operations
- D. Colors shall be as selected by the Architect from the
manufacturer's standard palatte.
- E. Provide the manufacturer's flexible urethane sealant to be used
where drywall expansion or isolation joints occur in the epoxy
wall system.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Substrate: Drywall shall be clean and free of bond inhibiting
materials such as previously applied coatings. Preparation may
include light sanding.

3.2 APPLICATION

- A. General: Apply each component of resinous wall system in
compliance with manufacturer's directions to produce a uniform
monolithic wearing surface of thickness indicated, uninterrupted
except at divider strips, sawn joints or other types of joints (if
any), indicated or required.
- B. Provide a 1" fabric tape detail around all penetrations in the
gypsum board walls.
- C. Primer: Mix and apply primer over properly prepared substrate with
reference to manufacturer's installation procedures and coverage
rates.
- D. Coating: Mix material according to manufacturer's recommended
procedures. Note that solvent reduction of any kind is strictly
prohibited. Apply material immediately after mixing using high
quality rollers or an airless sprayer. Strict adherence to
manufacturer's coverage rates is imperative. Apply in two coats to
provide evenly with no runs.

3.3 CURING, PROTECTION AND CLEANING

- A. Cure epoxy wall materials in compliance with manufacturer's
directions, taking care to prevent contamination during stages of

application and prior to completion of curing process. Close area of application for a minimum of 24 hours.

- B. Protect epoxy wall materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application.
- C. Cleaning: Remove temporary covering and clean resinous wall system just prior to final inspection. Use cleaning materials and procedures recommended by epoxy wall system manufacturer.

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SECTION 09 68 00

CARPETING

PART 1 - GENERAL

1.1 DESCRIPTION

Section specifies carpet, edge strips, adhesives, and other items required for complete installation.

1.2 RELATED WORK

- A. Color and texture of carpet and edge strip: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Resilient wall base: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

1.3 QUALITY ASSURANCE

- A. Carpet installed by mechanics certified by the Floor Covering Installation Board.
- B. Certify and label the carpet that it has been tested and meets criteria of CRI IAQ Carpet Testing Program for indoor air quality.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data:
 - 1. Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading and flame resistance characteristics for each type of carpet material and installation accessory.
 - 2. Manufacturer's printed installation instructions for the carpet, including preparation of installation substrate, seaming techniques and recommended adhesives and tapes.
 - 3. Manufacturer's certificate verifying carpet containing recycled materials include percentage of recycled materials as specified.
- C. Samples:
 - 1. Carpet: "Production Quality" samples of carpet, showing quality, pattern and color specified in Section 09 06 00, SCHEDULE FOR FINISHES.
 - 2. Floor Edge Strip (Molding): 150 mm (6 inches) long of each color and type specified.
 - 3. Base Edge Strip (Molding): 150 mm (6 inches) long of each color specified.

- D. Shop Drawings: Installers layout plan showing seams and cuts for sheet carpet and carpet module.
- E. Maintenance Data: Carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods and cleaning cycles.

1.5 DELIVERY AND STORAGE

- A. Deliver carpet in manufacturer's original wrappings and packages clearly labeled with manufacturer's name, brand, name, size, dye lot number and related information.
- B. Deliver adhesives in containers clearly labeled with manufacturer's name, brand name, number, installation instructions, safety instructions and flash points.
- C. Store in a clean, dry, well ventilated area, protected from damage and soiling. Maintain storage space at a temperature above 16 degrees C (60 degrees F) for 2 days prior to installation.

1.6 ENVIRONMENTAL REQUIREMENTS

Areas in which carpeting is to be installed shall be maintained at a temperature above 16 degrees C (60 degrees F) for 2 days before installation, during installation and for 2 days after installation. A minimum temperature of 13 degrees C (55 degrees F) shall be maintained thereafter for the duration of the contract. Traffic or movement of furniture or equipment in carpeted area shall not be permitted for 24 hours after installation. Other work which would damage the carpet shall be completed prior to installation of carpet.

1.7 WARRANTY

Carpet and installation subject to terms of "Warranty of Construction" FAR clause 52.246-21, except that warranty period is extended to two years.

1.8 APPLICABLE PUBLICATIONS

- A. Publication 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):

ANSI/NSF 140-07.....Sustainable Carpet Assessment Standard
- C. American Association of Textile Chemists and Colorists (AATCC):

AATCC 16-04.....Colorfastness to Light

AATCC 129-05.....Colorfastness to Ozone in the Atmosphere
under High Humidities

AATCC 134-06.....Electric Static Propensity of Carpets

AATCC 165-99.....Colorfastness to Crocking: Textile Floor
Conerings-AATCC Crockmeter Method
- D. American Society for Testing and Materials (ASTM):

ASTM D1335-05.....Tuft Bind of Pile Yarn Floor Coverings

ASTM D3278-96 (R2004)...Flash Point of Liquids by Small Scale
Closed-Cup Apparatus

ASTM D5116-06.....Determinations of Organic Emissions from
Indoor Materials/Products

ASTM D5252-05.....Operation of the Hexapod Tumble Drum
Tester

ASTM D5417-05.....Operation of the Vettermann Drum Tester

ASTM E648-06.....Critical Radiant Flux of Floor-Covering
Systems Using a Radiant Heat Energy Source

E. The Carpet and Rug Institute (CRI):

CRI 104-02.....Installation of Commercial Carpet

PART 2 - PRODUCTS

2.1 CARPET

A. Subject to compliance with specified requirements, carpet shall be the products of Milliken & Company, or "Or Equal" products by one of the following manufacturers will also be acceptable:

1. Couristan Inc.
2. Mohawk Carpet Co.
3. Lees Commercial Carpet.
4. Bentley Mills Inc.

B. Physical Characteristics:

1. Carpet free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains and other physical and manufacturing defects, not less than 27 oz/sq/yd.
2. Manufacturers standard construction commercial carpet:
 - a. Broadloom; maximum width to minimum use.
 - b. Modular Tile: Square tile as standard with the manufacturer.
3. Provide static control to permanently control static build upto less than 2.0 kV when tested at 20 percent relative humidity and 21 degrees C (70 degrees F) in accordance with AATCC 134.
4. Pile Height: Maximum 3.25 mm (0.10 inch).
5. Pile Fiber: Nylon with recycled content 25 percent minimum branded (federally registered trademark).
6. Pile Type: Tufted Level Loop.
7. Backing materials: Manufacturer's unitary backing designed for glue-down installation using recovered materials.

8. Appearance Retention Rating (ARR): Carpet shall be tested and have the minimum 3.5-4.0 Severe ARR when tested in accordance with either the ASTM D 5252 (Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.
 9. Tuft Bind: Minimum force of 40 N (10 lb) required to pull a tuft or loop free from carpet backing. Test per ASTM D1335.
 10. Colorfastness to Crocking: Dry and wet crocking and water bleed, comply with AATCC 165 Color Transference Chart for colors, minimum class 4 rating.
 11. Colorfastness to Ozone: Comply with AATCC 129, minimum rating of 4 on the AATCC color transfer chart.
 12. Delamination Strength: Minimum of 440 N/m (2.5 lb/inch) between secondary backing.
 13. Flammability and Critical Radiant Flux Requirements:
 - a. Test Carpet in accordance with ASTM E 648.
 - b. Class I: Not less than 0.45 watts per square centimeter.
 - c. Class II: Not less than 0.22 watts per square centimeter.
 - d. Carpet in corridors, exits and Medical Facilities: Class I.
 14. Density: Average Pile Yarn Density (APYD):
 - a. Corridors, lobbies, entrances, common areas or multipurpose rooms, open offices, waiting areas and dining areas: Minimum APYD 6000.
 - b. Other areas: Minimum APYD 4000.
 15. VOC Limits: Use carpet and carpet adhesive that comply with the following limits for VOC content when tested according to ASTM D 5116:
 - a. Carpet, Total VOCs: 0.5 mg/sq.m x hr.
 - b. Carpet, 4-PC (4-Phenylcyclohexene): 0.05 mg/sq.m x hr.
 - c. Carpet, Formaldehyde: 0.05 mg/sq.m x hr.
 - d. Carpet, Styrene: 0.4 mg/sq.m x hr.
 - e. Adhesive, Total VOCs: 10.00 mg/sq.m x hr.
 - f. Adhesive, Formaldehyde: 0.05 mg/sq.m x hr.
 - g. Adhesive, 2-Ethyl-1-Hexanol: 3.00 mg/sq.m x hr.
- B. Shall meet platinum level of ANSI/NSF 140.

- C. Color, Texture, and Pattern: As specified in Section 09 06 00, SCHEDULE FOR FINISHES, and as selected by the Architect.

2.2 ADHESIVE AND CONCRETE PRIMER

- A. Waterproof, resistant to cleaning solutions, steam and water, nonflammable, complies with air-quality standards as specified. Adhesives flashpoint minimum 60 degrees C (140 degrees F), complies with ASTM D 3278.
- B. Seam Adhesives: Waterproof, non-flammable and non-staining.

2.3 SEAMING TAPE

- A. Permanently resistant to carpet cleaning solutions, steam, and water.
- B. Recommended by carpet manufacturer.

2.4 EDGE STRIPS (MOLDING)

- A. Metal:
 - 1. Hammered surface aluminum, pinless, clamp down type designed for the carpet being installed.
 - 2. Floor flange not less than 38 mm (1-1/2 inches) wide, face not less than 16 mm (5/8 inch) wide.
 - 3. Finish: Clear anodic coating unless specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Vinyl Edge Strip:
 - 1. Beveled floor flange minimum 50 mm (2 inches) wide.
 - 2. Beveled surface to finish flush with carpet for tight joint and other side to floor finish.
 - 3. Color as specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Carpet Base Top Edge Strip:
 - 1. Vinyl "J" strip wall flange minimum of 38 mm (1-1/2 inches) wide with cap beveled from wall to finish flush with carpet being installed.
 - 2. Color as specified in Section 09 06 00, SCHEDULE FOR FINISHES.

2.5 LEVELING COMPOUND (FOR CONCRETE FLOORS)

- A. Provide Portland cement bases polymer modifier with latex or polyvinyl acetate resin manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
- B. Determine the type of underlayment selected for use by condition to be corrected.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Examine surfaces on which carpeting is to be installed.
- B. Clean floor of oil, waxy films, paint, dust and deleterious substances that prevent adhesion, leave floor dry and cured, free of residue from curing or cleaning agents and existing carpet materials.
- C. Correct conditions which will impair proper installation, including trowel marks, pits, dents, protrusions, cracks or joints.
- D. 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.
- E. Test new concrete subfloor prior to adhesive application for moisture and surface alkalinity per CRI 104 Section 6.3.1 or per ASTM E1907.

3.2 CARPET INSTALLATION

- A. Do not install carpet until work of other trades including painting is complete and dry.
- B. Install in accordance with CRI 104 direct glue down installation.
 - 1. Relax carpet in accordance with Section 6.4.
 - 2. Comply with indoor air quality recommendations noted in Section 6.5.
 - 3. Maintain temperature in accordance with Section 15.3.
- C. Secure carpet to subfloor of spaces with adhesive applied as recommended by carpet manufacturer.
- D. Follow carpet manufacturer's recommendations for matching pattern and texture directions.
- E. Cut openings in carpet where required for installing equipment, pipes, outlets, and penetrations.
 - 1. Bind or seal cut edge of sheet carpet and replace flanges or plates.
 - 2. Use additional adhesive to secure carpets around pipes and other vertical projections.
- G. Broadloom Carpet:

1. Install per CRI 104, Section 8.
2. Lay broadloom carpet lengthwise in longest dimension of space, with minimum seams, uniformly spaced to provide a tight smooth finish, free from movement when subjected to traffic.
3. Use tape-seaming method to join sheet carpet edges. Do not leave visible seams.

H. Carpet Modules:

1. Install per CRI 104, Section 13, Adhesive Application.
2. Lay carpet modules with pile in same direction unless specified other wise in Section 09 06 00, SCHEDULE FOR FINISHES.
3. Install carpet modules so that cleaning methods and solutions do not cause dislocation of modules.
4. Lay carpet modules uniformly to provide tight flush joints free from movement when subject to traffic.

3.3 EDGE STRIPS INSTALLATION

- A. Install edge strips over exposed carpet edges adjacent to uncarpeted finish flooring.
- B. Anchor metal strips to floor with suitable fasteners. Apply adhesive to edge strips, insert carpet into lip and press it down over carpet.
- C. Anchor vinyl edge strip to floor with adhesive apply adhesive to edge strip and insert carpet into lip and press lip down over carpet.
- D. Carpet Base Top Edge Strip Installation:
 1. Place carpet molding at top edge of carpet where turned up as base.
 2. Install molding in accordance with manufacturer's instructions.

3.4 PROTECTION AND CLEANING

- A. Remove waste, fasteners and other cuttings from carpet floors.
- B. Vacuum carpet and provide suitable protection. Do not use polyethylene film.
- C. Do not permit traffic on carpeted surfaces for at least 48 hours after installation. Protect the carpet in accordance with CRI 104.
- D. Do not move furniture or equipment on unprotected carpeted surfaces.
- E. Just before final acceptance of work, remove protection and vacuum carpet clean.

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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. Shop prime painting of steel and ferrous metals: Division 05 - METALS, Division 08 - OPENINGS, Division 10 - SPECIALTIES, Division 11 - EQUIPMENT, Division 12 - FURNISHINGS, Division 13 - SPECIAL CONSTRUCTION, Division 14 - CONVEYING EQUIPMENT, Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 - ELECTRONIC SAFETY AND SECURITY sections.
- B. Contractor option: Prefinished flush doors with transparent finishes: Section 08 14 00, WOOD DOORS.
- C. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.
- D. Glazed wall surfacing or tile like coatings: Section 09 96 59,

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, 100 by 250 by 3 mm (4 inch by 10 inch by 1/8 inch).
 3. Panel to show transparent finishes: Wood of same species and grain pattern as wood approved for use, 100 by 250 by 3 mm (4 inch by 10 inch face by 1/4 inch) thick minimum, and where both flat and edge grain will be exposed, 250 mm (10 inches) long by sufficient size, 50 by 50 mm (2 by 2 inch) minimum or actual wood member to show complete finish.
 4. Attach labels to panel stating the following:
 - a. Federal Specification Number or manufacturers name and product number of paints used.
 - b. Specification code number specified in Section 09 06 00, SCHEDULE FOR FINISHES.
 - c. Product type and color.
 - d. Name of project.
 5. Strips showing not less than 50 mm (2 inch) wide strips of undercoats and 100 mm (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. High temperature aluminum paint.
 3. Epoxy coating.
 4. Intumescent clear coating or fire retardant paint.
 5. Plastic floor coating.

1.4 DELIVERY AND STORAGE

- A. Deliver materials to site in manufacturer's sealed container marked to show following:
1. Name of manufacturer.
 2. Product type.
 3. Batch number.
 4. Instructions for use.
 5. Safety precautions.
- B. In addition to manufacturer's label, provide a label legibly printed as following:
1. Federal Specification Number, where applicable, and name of material.

2. Surface upon which material is to be applied.
 3. If paint or other coating, state coat types; prime, body or finish.
- C. Maintain space for storage, and handling of painting materials and equipment in a neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.
- D. Store materials at site at least 24 hours before using, at a temperature between 18 and 30 degrees C (65 and 85 degrees F).

1.5 MOCK-UP PANEL

- A. Before starting application of water paint mixtures, apply paint as specified to an area, not to exceed 9 m² (100 ft²), selected by Project Engineer.
- B. Finish and texture approved by Project Engineer 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-2008.....Threshold Limit Values (TLV) for
Chemical Substances and Physical Agents
and Biological Exposure Indices (BEIs)
- ACGIH TLV-DOC-2008.....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. 1-07.....Aluminum Paint (AP)

No. 4-07.....Interior/ Exterior Latex Block Filler

No. 5-07.....Exterior Alkyd Wood Primer

No. 7-07.....Exterior Oil Wood Primer

No. 8-07.....Exterior Alkyd, Flat MPI Gloss Level 1 (EO)

No. 9-07.....Exterior Alkyd Enamel MPI Gloss Level 6 (EO)

No. 10-07.....Exterior Latex, Flat (AE)

No. 11-07.....Exterior Latex, Semi-Gloss (AE)

No. 18-07.....Organic Zinc Rich Primer

No. 22-07.....Aluminum Paint, High Heat (up to 590% -
1100F) (HR)

No. 26-07.....Cementitious Galvanized Metal Primer

No. 27-07.....Exterior / Interior Alkyd Floor Enamel, Gloss
(FE)

No. 31-07.....Polyurethane, Moisture Cured, Clear Gloss
(PV)

No. 36-07.....Knot Sealer

No. 43-07.....Interior Satin Latex, MPI Gloss Level 4

No. 44-07.....Interior Low Sheen Latex, MPI Gloss Level 2

No. 45-07.....Interior Primer Sealer

No. 46-07.....Interior Enamel Undercoat

No. 47-07.....Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
(AK)

No. 48-07.....Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)

No. 49-07.....Interior Alkyd, Flat, MPI Gloss Level 1 (AK)

No. 50-07.....Interior Latex Primer Sealer

No. 51-07.....Interior Alkyd, Eggshell, MPI Gloss Level 3

No. 52-07.....Interior Latex, MPI Gloss Level 3 (LE)

No. 53-07.....Interior Latex, Flat, MPI Gloss Level 1 (LE)

No. 54-07.....Interior Latex, Semi-Gloss, MPI Gloss Level 5
(LE)

No. 59-07.....Interior/Exterior Alkyd Porch & Floor Enamel,
Low Gloss (FE)

No. 60-07.....Interior/Exterior Latex Porch & Floor Paint,
Low Gloss

No. 66-07.....Interior Alkyd Fire Retardant, Clear Top-Coat
(ULC Approved) (FC)

No. 67-07.....Interior Latex Fire Retardant, Top-Coat (ULC
Approved) (FR)

No. 68-07.....Interior/ Exterior Latex Porch & Floor Paint,
Gloss

No. 71-07.....Polyurethane, Moisture Cured, Clear, Flat
(PV)

No. 74-07.....Interior Alkyd Varnish, Semi-Gloss

No. 77-07.....Epoxy Cold Cured, Gloss (EC)

No. 79-07.....Marine Alkyd Metal Primer

No. 90-07.....Interior Wood Stain, Semi-Transparent (WS)

No. 91-07.....Wood Filler Paste

No. 94-07.....Exterior Alkyd, Semi-Gloss (EO)

No. 95-07.....Fast Drying Metal Primer

No. 98-07.....High Build Epoxy Coating

No. 101-07.....Epoxy Anti-Corrosive Metal Primer

No. 108-07.....High Build Epoxy Coating, Low Gloss (EC)

No. 114-07.....Interior Latex, Gloss (LE) and (LG)

No. 119-07.....Exterior Latex, High Gloss (acrylic) (AE)

No. 135-07.....Non-Cementitious Galvanized Primer

No. 138-07.....Interior High Performance Latex, MPI Gloss
Level 2 (LF)

No. 139-07.....Interior High Performance Latex, MPI Gloss
Level 3 (LL)

No. 140-07.....Interior High Performance Latex, MPI Gloss
Level 4

No. 141-07.....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 MATERIALS

- A. manufacturer: Subject to compliance with specified requirements, provide the products of vista paint Co. or "or equal" products of one of the following:
 - 1. ICI Dulux
 - 2. Dunn-Edwards
 - 3. Frazee
 - 4. Sherwin-Williams
 - 5. Benjamin Moore & Co.
 - 6. PPG Industries
 - 7. Kelley-Moore Paint Co.
- B. Interior Waterborne Epoxy, White and Pastel Base by Rustoleum, Tnemec, Ameron, or equal.
- C. Cementitious Paint (CEP): TT-P-1411A [Paint, Copolymer-Resin, Cementitious (CEP)], Type I for exterior use, Type II for interior use.
- D. Wood Sealer: MPI 31 (gloss) or MPI 71 (flat) thinned with thinner recommended by manufacturer at rate of about one part of thinner to four parts of varnish.
- E. Plastic Tape:
 - 1. Pigmented vinyl plastic film in colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES or specified.
 - 2. Pressure sensitive adhesive back.
 - 3. Widths as shown.
- F. Identity markers options:
 - 1. Pressure sensitive vinyl markers.
 - 2. Snap-on coil plastic markers.
- E. Aluminum Paint (AP): MPI 1.
- F. Interior/Exterior Latex Block Filler: MPI 4.
- G. Exterior Alkyd Wood Primer: MPI 5.
- H. Exterior Oil Wood Primer: MPI 7.
- I. Exterior Alkyd, Flat (EO): MPI 8.
- J. Exterior Alkyd Enamel (EO): MPI 9.
- K. Exterior Latex, Flat (AE): MPI 10.
- L. Exterior Latex, Semi-Gloss (AE): MPI 11.
- M. Organic Zinc rich Coating (HR): MPI 22.
- N. High Heat Resistant Coating (HR): MPI 22.

- O. Cementitious Galvanized Metal Primer: MPI 26.
- P. Exterior/ interior Alkyd Floor Enamel, Gloss (FE): MPI 27.
- Q. Knot Sealer: MPI 36.
- R. Interior Satin Latex: MPI 43.
- S. Interior Low Sheen Latex: MPI 44.
- T. Interior Primer Sealer: MPI 45.
- U. Interior Enamel Undercoat: MPI 47.
- V. Interior Alkyd, Semi-Gloss (AK): MPI 47.
- W. Interior Alkyd, Gloss (AK): MPI 49.
- X. Interior Latex Primer Sealer: MPI 50.
- Y. Interior Alkyd, Eggshell: MPI 51
- Z. Interior Latex, MPI Gloss Level 3 (LE): MPI 52.
- AA. Interior Latex, Flat, MPI Gloss Level 1 (LE): MPI 53.
- BB. Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE): MPI 54.
- DD. Interior / Exterior Alkyd Porch & Floor Enamel, Low Gloss (FE): MPI 59.
- EE. Interior/ Exterior Latex Porch & Floor Paint, Low Gloss: MPI 60.
- FF. Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved) (FC): MPI 66.
- GG. Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR): MPI 67.
- HH. Interior/ Exterior Latex Porch & Floor Paint, gloss: MPI 68.
- II. Epoxy Cold Cured, Gloss (EC): MPI 77.
- JJ. Marine Alkyd Metal primer: MPI 79.
- KK. Interior Wood Stain, Semi-Transparent (WS): MPI 90.
- LL. Wood Filler Paste: MPI 91.
- MM. Exterior Alkyd, Semi-Gloss (EO): MPI 94.
- NN. Fast Drying Metal Primer: MPI 95.
- OO. High Build Epoxy Coating: MPI 98.
- PP. Epoxy Anti-Corrosive Metal Primer: MPI 101.
- QQ. High Build Epoxy Marine Coating (EC): MPI 108.
- RR. Interior latex, Gloss (LE) and (LG): MPI 114.

- SS. Exterior Latex, High Gloss (acrylic) (AE): MPI 119.
- TT. Waterborne Galvanized Primer: MPI 134.
- UU. Non-Cementitious Galvanized Primer: MPI 135.
- VV. Interior High Performance Latex, MPI Gloss Level 2(LF): MPI 138.
- WW. Interior High Performance Latex, MPI Gloss Level 3 (LL): MPI 139.
- XX. Interior High Performance Latex, MPI Gloss Level 4: MPI 140.
- YY. Interior High Performance Latex (SG), MPI Gloss Level 5: MPI 141.

2.2 PAINT PROPERTIES

- A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.
- B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

2.3 REGULATORY REQUIREMENTS/QUALITY ASSURANCE

- A. Paint materials shall conform to the restrictions of the local Environmental and Toxic Control jurisdiction.
 - 1. Volatile Organic Compounds (VOC): VOC content of paint materials shall not exceed 10g/l for interior latex paints/primers and 50g/l for exterior latex paints and primers.
 - 2. Lead-Base Paint:
 - a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
 - b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
 - c. For lead-paint removal, see Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
 - 3. Asbestos: Materials shall not contain asbestos.
 - 4. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
 - 5. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.

6. Use high performance acrylic paints in place of alkyd paints, where possible.
7. VOC content for solvent-based paints shall not exceed 250g/l and shall not be formulated with more than one percent aromatic hydro carbons by weight.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
 1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
 2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each days work.
- B. Atmospheric and Surface Conditions:
 1. Do not apply coating when air or substrate conditions are:
 - a. Less than 3 degrees C (5 degrees F) above dew point.
 - b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.
 2. Maintain interior temperatures until paint dries hard.
 3. Do no exterior painting when it is windy and dusty.
 4. Do not paint in direct sunlight or on surfaces that the sun will soon warm.
 5. Apply only on clean, dry and frost free surfaces except as follows:
 - a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces where allowed by manufacturer's printed instructions.
 - b. Dampened with a fine mist of water on hot dry days concrete and masonry surfaces to which water thinned acrylic and cementitious paints are applied to prevent excessive suction and to cool surface.
 6. Varnishing:
 - a. Apply in clean areas and in still air.
 - b. Before varnishing vacuum and dust area.

- c. Immediately before varnishing wipe down surfaces with a tack rag.

3.2 SURFACE PREPARATION

- A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.
- B. General:
 - 1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
 - 2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
 - 3. See other sections of specifications for specified surface conditions and prime coat.
 - 4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.
- C. 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, and Copper and Copper Alloys 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. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three days and brush thoroughly free of crystals.
 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 25 mm (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 two component and two part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
- E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.4 APPLICATION

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
- B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
- C. Apply each coat evenly and cover substrate completely.
- D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by Resident Engineer.
- 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 Project Engineer, 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 sterilizes and other recessed equipment and similar prefinished items.
- I. 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 and Wood Particleboard:
 - 1. Use same kind of primer specified for exposed face surface.
 - a. Exterior wood: MPI 7 (Exterior Oil Wood Primer) for new construction and MPI 5 (Exterior Alkyd Wood Primer) for repainting bare wood primer except where MPI 90 (Interior Wood Stain, Semi-Transparent (WS)) is scheduled.
 - b. Interior wood except for transparent finish: MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat), thinned if recommended by manufacturer.
 - c. Transparent finishes as specified under Transparent Finishes on Wood except Floors.
 - 2. Apply two coats of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) to surfaces of wood doors, including top and bottom edges, which are cut for fitting or for other reason.
 - 3. Apply one coat of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel

Undercoat) as soon as delivered to site to surfaces of unfinished woodwork, except concealed surfaces of shop fabricated or assembled millwork and surfaces specified to have varnish, stain or natural finish.

4. Back prime and seal ends of exterior woodwork, and edges of exterior plywood specified to be finished.
5. Apply MPI 67 (Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR) to wood for fire retardant finish.

F. Metals except boilers, incinerator stacks, and engine exhaust pipes:

1. Steel and iron: MPI 79 (Marine Alkyd Metal Primer), MPI 95 (Fast Drying Metal Primer). Use MPI 101 (Cold Curing Epoxy Primer) where MPI 77 (Epoxy Cold Cured, Gloss (EC)), MPI 98 (High Build Epoxy Coating), or MPI 108 (High Build Epoxy Marine Coating (EC)) finish is specified.
2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer) or MPI 135 (Non-Cementitious Galvanized Primer).
3. Aluminum scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
4. Terne Metal: MPI 79 (Marine Alkyd Metal Primer) or MPI 95 (Fast Drying Metal Primer).
5. Copper and copper alloys scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
6. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel (EO)).
7. Asphalt coated metal: MPI 1 (Aluminum Paint (AP)).
8. Metal over 94 degrees C. (200 degrees F), Boilers, Incinerator Stacks, and Engine Exhaust Pipes: MPI 22 (High Heat Resistant Coating (HR)).

G. Gypsum Board and Hardboard:

1. Surfaces scheduled to have MPI 10 (Exterior Latex, Flat (AE)), MPI 11 (Exterior Latex, Semi-Gloss (AE)), MPI 119 (Exterior Latex, High Gloss (acrylic) (AE)), or MPI 53 (Interior Latex, Flat), MPI Gloss Level 1 (LE)) MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)), or MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)) MPI 114 (Interior Latex, Gloss (LE) and (LG)) finish: Use MPI 10 (Exterior Latex, Flat (AE)), MPI 11 (Exterior Latex, Semi-Gloss (AE)), MPI 119 (Exterior Latex, High Gloss (acrylic) (AE)) or MPI 53 (Interior Latex, MPI Gloss Level 3 (LE)), MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)), or MPI 114 (Interior Latex, Gloss (LE) and (LG)) respectively.
2. Primer: MPI 50 (Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer) MPI 46 (Interior Enamel Undercoat) in shower and bathrooms.

3. Surfaces scheduled to receive vinyl coated fabric wallcovering:
Use MPI 45 (Interior Primer Sealer) MPI 46 (Interior Enamel Undercoat).
 4. Use MPI 101 (Cold Curing Epoxy Primer) for surfaces scheduled to receive MPI 77 (Epoxy Cold Cured, Gloss (EC)), MPI 98 (High Build Epoxy Coating), or MPI 108 (High Build Epoxy Marine Coating (EC)) finish.
- H. Gypsum Plaster and Veneer Plaster:
1. Surfaces scheduled to receive vinyl coated fabric wallcovering:
Use MPI 45 (Interior Primer Sealer).
 2. MPI 45 (Interior Primer Sealer), except use MPI 50 (Interior Latex Primer Sealer) when an alkyd flat finish is specified.
 3. Surfaces scheduled to have MPI 10 (Exterior Latex, Flat (AE)), MPI 11 (Exterior Latex, Semi-Gloss (AE)), MPI 119 (Exterior Latex, High Gloss (acrylic) (AE)), or MPI 53 (Interior Latex, Flat, MPI Gloss Level 1 LE)) or MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)), or MPI 114 (Interior Latex, Gloss (LE) and (LG)) finish: Use MPI 10 (Exterior Latex, Flat (AE)), MPI 11 (Exterior Latex, Semi-Gloss (AE)), MPI 119 (Exterior Latex, High Gloss (acrylic) (AE)) or MPI 53 (Interior Latex, Flat, MPI Gloss Level 1 LE)) MPI 52 Latex, MPI Gloss Level 3 (LE)), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)), or MPI 114 (Interior Latex, Gloss (LE) and (LG)) respectively.
 4. Use MPI 101 (Cold Curing Epoxy Primer) for surfaces scheduled to receive, MPI 77 (Epoxy Cold Cured, Gloss (EC)), or MPI 108 (High Build Epoxy Marine Coating (EC)) finish.
- I. Concrete Masonry Units except glazed or integrally colored and decorative units:
1. MPI 4 (Block Filler) on interior surfaces.
 2. Prime exterior surface as specified for exterior finishes.
- J. Cement Plaster or stucco, Concrete Masonry, Brick Masonry, and Cement board Interior Surfaces of Ceilings and Walls:
1. MPI 53 (Interior Latex, Flat, MPI Gloss Level 1 LE)), MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)), MPI 114 (Interior Latex, Gloss (LE) and (LG)), except use two coats where substrate has aged less than six months.
 2. Use MPI 138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)), MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)), MPI 140 (Interior High Performance latex, MPI Gloss Level 4) MPI 141 (Interior High Performance Latex (SG) MPI Gloss Level 5), MPI 114 (Interior Latex, Gloss (LE) and (LG)), TT-P-1411A (Paint, Copolymer Resin, Cementitious (CEP)) Type II, MPI 77 (Epoxy Cold Cured, Gloss (EC)), MPI 98 (High Build Epoxy Coating), MPI 108 (High Build

Epoxy Marine Coating (EC)) or CID-A-A-1555 (Water, Paint, Powder) as scheduled.

- K. Concrete Floors: MPI 68 (Interior/ Exterior Latex Porch & Floor Paint, Gloss), or MPI 60 (Interior/ Exterior Latex Porch & Floor Paint, Low Gloss).

3.6 EXTERIOR FINISHES

- A. Apply following finish coats where specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Wood:
 - 1. Do not apply finish coats on surfaces concealed after installation, top and bottom edges of wood doors and sash, or on edges of wood framed insect screens.
 - 2. Portion of sash runs of double hung wood windows, concealed by sash when in a closed position: Apply two coats of ASTM D260 mixed with not more than 0.12L (1/4 pint) of dryer per 3.89L (gallon).
 - 3. Two coats of MPI 10 Exterior Latex, Flat (AE)), MPI 11 (Exterior Latex, Semi-Gloss (AE)), or MPI 119 (Exterior Latex, High Gloss (acrylic) (AE)) on exposed surfaces, except where transparent finish is specified.
 - 4. Two coats of MPI 31 (Polyurethane, Moisture Cured, Clear Gloss (PV)) or MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV)) for transparent finish.
- C. Steel and Ferrous Metal, Including Tern:
 - 1. Two coats of MPI 8 (Exterior Alkyd, Flat (EO)), MPI 9 (Exterior Alkyd Enamel (EO)) or MPI 94 (Exterior Alkyd, Semi-Gloss (EO)) on exposed surfaces, except on surfaces over 94 degrees C (200 degrees F).
 - 2. One coat of MPI 22 (High Heat Resistant Coating (HR)) on surfaces over 94 degrees K (200 degrees F) and on surfaces of boiler, incinerator or stacks engine exhaust pipes.
- D. Machinery without factory finish except for primer: One coat MPI 8 (Exterior Alkyd, Flat (EO)), MPI 9 (Exterior Alkyd Enamel (EO)), or MPI 94 (Exterior Alkyd, Semi-Gloss (EO)).
- E. Concrete Masonry Units Brick, Cement Plaster, or Concrete:
 - 1. General:
 - a. Where specified in Section 09 06 00, SCHEDULE FOR FINISHES or shown.
 - b. Mix as specified in manufacturer's printed directions.
 - c. Do not mix more paint at one time than can be used within four hours after mixing. Discard paint that has started to set.

- d. Dampen warm surfaces above 24 degrees C (75 degrees F) with fine mist of water before application of paint. Do not leave free water on surface.
 - e. Cure paint with a fine mist of water as specified in manufacturer's printed instructions.
- 2. Use two coats of TT-P-1411 (Paint, Co-polymer-Resin, Cementitious (CEP)), unless specified otherwise.

3.7 INTERIOR FINISHES

- A. Apply following finish coats over prime coats in spaces or on surfaces specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Metal Work:
 - 1. Apply to exposed surfaces.
 - 2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
 - 3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
 - a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) unless specified otherwise.
 - b. Two coats of MPI 48 (Interior Alkyd Gloss (AK)) MPI 51 (Interior Alkyd, Eggshell (AK)).
 - c. One coat of MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) on exposed interior surfaces of alkyd-amine enamel prime finished windows.
 - d. Two coats of CID-A-A3120 Type E (RP) on exposed surfaces in battery rooms, pool area or chlorinator rooms.
 - e. Machinery: One coat MPI 9 (Exterior Alkyd Enamel (EO)).
 - f. Asphalt Coated Metal: One coat MPI 1 (Aluminum Paint (AP)).
 - g. Ferrous Metal over 94 degrees K (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), MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)).
 - 2. Two coats of MPI 138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)).
 - 3. One coat of MPI 45 (Interior Primer Sealer), or MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 54

(Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)) or MPI 114 (Interior Latex, Gloss (LE) and (LG)).

4. One coat of MPI 45 (Interior Primer Sealer), MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 48 (Interior Alkyd Gloss (AK)).

D. Plaster:

1. One coat of MPI 45 (Interior Primer Sealer), MPI 46 (Interior Enamel Undercoat), MPI 50 (Interior Latex Primer Sealer) plus one coat of MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)).
2. Two coats of MPI 51 (Interior Alkyd, Eggshell) (AK)).
3. One coat of MPI 45 (Interior Primer Sealer), MPI 46 (Interior Enamel Undercoat) or MPI 50 (Interior Latex Primer Sealer) plus one coat of 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)).
4. One coat MPI 101 (Cold Curing Epoxy Prime (EC)).

E. Masonry and Concrete Walls:

1. Over MPI 4 (Interior/Exterior Latex Block Filler) on CMU surfaces.
2. Two coats of MPI 53 (Interior Latex, Flat, MPI Gloss Level 1 (LE)), MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)) or MPI 114 (Interior Latex, Gloss (LE) and (LG)).
3. Two coats of MPI 138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)), MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)), MPI 140 (Interior High Performance Latex MPI Gloss level 4, MPI 141 (Interior High Performance Latex (SG) MPI Gloss level 5) and MPI 114 (Interior Latex, Gloss (LE) and (LG)).

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:
 - a. One coat of MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) (SG).
 - b. One coat MPI 66 (Interior Alkyd Fire retardant, Clear Top-Coat (ULC Approved) (FC) or MPI 67 (Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR), intumescent type (FR), on exposed wood in attics with floors used for mechanical equipment and above ceilings where shown.
 - c. One coat of MPI 45 Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 48 (Interior Alkyd Gloss (AK)).
 - d. Two coats of MPI 51 (Interior Alkyd, Eggshell) (AK)).
- 4. Transparent Finishes on Wood Except Floors.
 - a. Natural Finish:
 - 1) One coat of sealer as written in 2.1 E.
 - 2) Two coats of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV) MPI 31 (Polyurethane, Moisture Cured, Clear Gloss (PV)).
 - b. 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 71 (Polyurethane, Moisture Cured, Clear Flat (PV) or MPI 31 (Polyurethane Moisture Cured, Clear Gloss (PV)).
 - c. Varnish Finish:
 - 1) One coat of sealer.
 - 2) Two coats of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV) or MPI 31 (Polyurethane Moisture Cured, Clear Gloss (PV)).
 - d. MPI 66 (Interior Alkyd Fire Retardant, Clear Top-Coat(ULC Approved) (FC)) Intumescent Type, Fire Retardant Coating (FC) where scheduled: Two coats.

- 5. Finish for Wood Floors:
 - a. Hardwood Flooring:
 - 1) Apply MPI 91 (Wood Filler Paste) to open grained wood. Remove surplus filler and wipe clean.
 - 2) Sand lightly when dry. Remove dust.
 - 3) Apply two coats of CID-A-A-2335 (Sealer, Surface).
 - 4) Apply two thin coats of P-W-155 (Wax Floor, Water Emulsion) and machine buff to uniform luster.
 - b. Stage Floor: Sand only. No filling, sealing, or waxing is required.
 - c. Exercise Area Recreation Hall, Gymnasium, or Handball Boards in Exercise Area Floor Finish:
 - 1) Two coats of CID-A-A-2335 (Sealer, Surface).
 - 2) Two coats of coating as written in 2.1 D (PL). Coating applied evenly in direction of boards and free from streaks.
 - 3) Allow 48 hours between coats.
 - 4) Apply in one continuous operation with squeegee or lambs wool applicator with application free from streaks in accordance with plastic coating manufacturer's directions.
 - d. Striping:
 - 1) Where striping is shown for wood floors apply plastic tape stripes as written in 2.1 F.
 - 2) Do striping when floor coating is dry.
 - 3) Install stripes to straight lines and true curves as shown.
- G. Cement Board: One coat of PI 138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)), or MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)) MPI 140 (Interior High Performance Latex MPI Gloss level 4) MPI 141 (Interior High Performance Latex (SG) MPI Gloss Level 5 or MPI 114 (Interior Latex, Gloss (LE) and (LG)).
- H. Concrete Floors: One coat of MPI 68 (Interior/ Exterior Latex Porch & Floor Paint, Gloss (FE)).
- I. Miscellaneous:
 - 1. Apply where specified in Section 09 06 00, SCHEDULE FOR FINISHES.

2. MPI 1 (Aluminum Paint): Two coats of aluminum paint.
3. Gold Paint (GP): Two coats of gold paint.
4. Existing acoustical units scheduled to be repainted except acoustical units with a vinyl finish:
 - a. Clean units free of dust, dirt, grease, and other deterrents to paint adhesion.
 - b. Mineral fiber units: One coat of MPI 53 (Interior Latex, Flat, MPI Gloss Level 1 (LE)), MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)) or MPI 114 (Interior Latex, Gloss (LE) and (LG)).
 - c. Units of organic fiber or other material not having a class A rating: One coat of MPI 66 (Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved) (FC)) or MPI 67 (Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR)) or fire retardant paint.
5. Interstitial floor markings: One coat, MPI 27 (Exterior/ Interior Alkyd Floor Enamel, Gloss (FE)), MPI 59 ((Interior/ Exterior Alkyd Porch & Floor Enamel, Low Gloss (FE)), MPI 68 (Interior/ Exterior Latex Porch & Floor Paint, Gloss) // MPI 60 (interior/ Exterior Latex Porch & Floor Paint, Low Gloss (FR)).

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) or MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV)).
- 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 specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. For additional requirements regarding color see Articles, REFINISHING EXISTING PAINTED SURFACE and MECHANICAL AND ELECTRICAL FIELD PAINTING SCHEDULE.
- C. Coat Colors:
 - 1. Color of priming coat: Lighter than body coat.
 - 2. Color of body coat: Lighter than finish coat.
 - 3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.
- D. Painting, Caulking, Closures, and Fillers Adjacent to Casework:
 - 1. Paint to match color of casework where casework has a paint finish.
 - 2. Paint to match color of wall where casework is stainless steel, plastic laminate, or varnished wood.

3.10 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 in Section 09 06 00, SCHEDULE FOR FINISHES paint as specified under paragraph H, colors.
- C. Paint after tests have been completed.
- D. Omit prime coat from factory prime-coated items.
- E. 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.
- F. Omit field painting of items specified in paragraph, Building and Structural WORK NOT PAINTED.
- G. Color:
 - 1. Paint items having no color specified in Section 09 06 00, SCHEDULE FOR FINISHES to match surrounding surfaces.
 - 2. Paint colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES except for following:

- a. WhiteExterior unfinished surfaces of enameled plumbing fixtures. Insulation coverings on breeching and uptake inside boiler house, drums and drum-heads, oil heaters, condensate tanks and condensate piping.
 - b. Gray:Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces), and water and sewage treatment equipment and sewage ejection equipment.
 - c. Aluminum Color: Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment, and steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).
 - d. Federal Safety Red: Exposed fire protection piping hydrants, post indicators, electrical conducts containing fire alarm control wiring, and fire alarm equipment.
 - e. Federal Safety Orange: .Entire lengths of electrical conduits containing feeders 600 volts or more.
 - f. Color to match brickwork sheet metal covering on breeching outside of exterior wall of boiler house.
- I. Apply paint systems on properly prepared and primed surface as follows:
- 1. Exterior Locations:
 - a. Apply two coats of MPI 8 (Exterior Alkyd, Flat (EO)) MPI 94 (Exterior Alkyd, Semi-gloss (EO)) or MPI 9 (Exterior Alkyd Enamel (EO)) to the following ferrous metal items:

Vent and exhaust pipes with temperatures under 94 degrees C
(200 degrees F), roof drains, fire hydrants, post indicators, yard hydrants, exposed piping and similar items.
 - b. Apply two coats of MPI 10 (Exterior Latex, Flat (AE)), MPI 11 (Exterior Latex, Semi Gloss (AE)) or MPI 119 (Exterior Latex, High Gloss (acrylic) (AE)) to the following metal items:

Galvanized and zinc-copper alloy metal.
 - c. Apply one coat of MPI 22 (High Heat Resistant Coating (HR)), 650 degrees C (1200 degrees F) to incinerator stacks, boiler stacks, and engine generator exhaust.
 - 2. Interior Locations:

- a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) to following items:
 - 1) Metal under 94 degrees C (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. Ferrous metal exposed in hydrotherapy equipment room and chlorinator room of water and sewerage treatment plants: One coat of MPI 101 (Cold Curing Epoxy Primer) and one coat of MPI 77 (Epoxy Cold Cured, Gloss (EC), MPI 98 (High Build Epoxy Coating)) or MPI 108 (High Build Epoxy Marine coating (EC)).
 - c. Apply one coat of MPI 50 (Interior Latex Primer Sealer) and one coat of MPI 53 (Interior Latex, Flat, MPI Gloss Level 1 (LE)) MPI 44 (Interior Low Sheen Latex). MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)), MPI 43 (Interior Satin Latex), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)), MPI 114 (Interior Latex, Gloss (LE) and (LG)) on finish of insulation on boiler breeching and uptakes inside boiler house, drums, drumheads, oil heaters, feed water heaters, tanks and piping.
 - d. Apply two coats of MPI 22 (High Heat Resistant Coating (HR)) to ferrous metal surface over 94 degrees K (200 degrees F) of following items:
 - 1) Garbage and trash incinerator.
 - 2) Medical waste incinerator.
 - 3) Exterior of boilers and ferrous metal in connection with boiler settings including supporting members, doors and door frames and fuel oil burning equipment.
 - 4) Steam line flanges, bare pipe, fittings, valves, hangers and supports over 94 degrees K (200 degrees F).
 - 5) Engine generator exhaust piping and muffler.
 - e. Paint electrical conduits containing cables rated 600 volts or more using two coats of MPI 9 (Exterior Alkyd Enamel (EO)) MPI 8 (Exterior Alkyd, Flat (EO)), MPI 94 (Exterior Alkyd, Semi-gloss (EO)) or in the Federal Safety Orange color in exposed and concealed spaces full length of conduit.
3. Other exposed locations:

- a. Metal surfaces, except aluminum, of cooling towers exposed to view, including connected pipes, rails, and ladders: Two coats of MPI 1 (Aluminum Paint (AP)).
- b. Cloth jackets of insulation of ducts and pipes in connection with plumbing, air conditioning, ventilating refrigeration and heating systems: One coat of MPI 50 (Interior Latex Primer Sealer) and one coat of MPI 10 (Exterior Latex, Flat (AE)), MPI 11 (Exterior Latex Semi-Gloss (AE)) or MPI 119 (Exterior Latex, High Gloss (acrylic)(AE)).

3.11 BUILDING AND STRUCTURAL WORK FIELD PAINTING

- A. Painting and finishing of interior and exterior work except as otherwise specified.
 - 1. Painting and finishing of new and existing work including colors and gloss of finish selected is specified in Finish Schedule, Section 09 06 00, SCHEDULE FOR FINISHES.
 - 2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
 - 3. Painting of ferrous metal and galvanized metal.
 - 4. Painting of wood with fire retardant paint exposed in attics, when used as mechanical equipment space, except shingles.
 - 5. Identity painting and safety painting.
- B. Building and Structural Work not Painted:
 - 1. Prefinished items:
 - a. Casework, doors, elevator entrances and cabs, metal panels, wall covering, and similar items specified factory finished under other sections.
 - b. Factory finished equipment and pre-engineered metal building components such as metal roof and wall panels.
 - 2. Finished surfaces:
 - a. Hardware except ferrous metal.
 - b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as otherwise specified.
 - c. Signs, fixtures, and other similar items integrally finished.
 - 3. Concealed surfaces:
 - a. Inside dumbwaiter, elevator and duct shafts, interstitial spaces, pipe basements, crawl spaces, pipe tunnels, above ceilings, attics, except as otherwise specified.

- b. Inside walls or other spaces behind access doors or panels.
 - c. Surfaces concealed behind permanently installed casework and equipment.
- 4. Moving and operating parts:
 - a. Shafts, chains, gears, mechanical and electrical operators, linkages, and sprinkler heads, and sensing devices.
 - b. Tracks for overhead or coiling doors, shutters, and grilles.
- 5. Labels:
 - a. Code required label, such as Underwriters Laboratories Inc., Inchcape Testing Services, Inc., or Factory Mutual Research Corporation.
 - b. Identification plates, instruction plates, performance rating, and nomenclature.
- 6. Galvanized metal:
 - a. Exterior chain link fence and gates, corrugated metal areaways, and gratings.
 - b. Gas Storage Racks.
 - c. Except where specifically specified to be painted.
- 7. Metal safety treads and nosings.
- 8. Gaskets.
- 9. Concrete curbs, gutters, pavements, retaining walls, exterior exposed foundations walls and interior walls in pipe basements.
- 10. Face brick.
- 11. Structural steel encased in concrete, masonry, or other enclosure.
- 12. Structural steel to receive sprayed-on fire proofing.
- 13. Ceilings, walls, columns in interstitial spaces.
- 14. Ceilings, walls, and columns in pipe basements.
- 15. Wood Shingles.

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 specified options or by stencil applications.
2. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12 000 mm (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.
3. Locate Legends clearly visible from operating position.
4. Use arrow to indicate direction of flow.
5. Identify pipe contents with sufficient additional details such as temperature, pressure, and contents to identify possible hazard. Insert working pressure shown on drawings where asterisk appears for High, Medium, and Low Pressure designations as follows:
 - a. High Pressure - 414 kPa (60 psig) and above.
 - b. Medium Pressure - 104 to 413 kPa (15 to 59 psig).
 - c. Low Pressure - 103 kPa (14 psig) and below.
 - d. Add Fuel oil grade numbers.
6. Legend name in full or in abbreviated form as follows:

	COLOR OF	COLOR OF	COLOR OF	LEGEND
PIPING	EXPOSED PIPING	BACKGROUND	LETTERS	BBREVIATIONS
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		Green	White	Fuel Oil-Grade ____*
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 50 mm (2 inch) high black numbers and letters, showing the voltage class rating. Provide legends where conduits pass through walls and floors and at maximum 6100 mm (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 64 mm (2 1/2 inches) high.
2. Stenciled message: "SMOKE BARRIER" or, "FIRE BARRIER" as applicable.
3. Locate not more than 6100 mm (20 feet) on center on corridor sides of partitions, and with a least one message per room on room side of partition.

4. Use semigloss paint of color that contrasts with color of substrate.
- C. Identify columns in pipe basements and interstitial space:
 1. Apply stenciled number and letters to correspond with grid numbering and lettering shown.
 2. Paint numbers and letters 100 mm (4 inches) high, locate 450 mm (18 inches) below overhead structural slab.
 3. Apply on four sides of interior columns and on inside face only of exterior wall columns.
 4. Color:
 - a. Use black on concrete columns.
 - b. Use white or contrasting color on steel columns.

3.14 PROTECTION CLEAN UP, AND TOUCH-UP

- A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
- B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.
- C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

- - - E N D - - -

APPENDIX

Coordinate the following abbreviations used in Section 09 91 00, PAINTING, with other Sections, especially Section 09 06 00, SCHEDULE FOR FINISHES and other COATING SECTIONS listed. Use the same abbreviation and terms consistently.

Paint or coating	Abbreviation
Acrylic Emulsion	AE (MPI 10 - flat/MPI 11 - semigloss/MPI 119 - gloss)
Alkyd Flat	Ak (MPI 49)
Alkyd Gloss Enamel	G (MPI 48)
Alkyd Semigloss Enamel	SG (MPI 47)
Aluminum Paint	AP (MPI 1)
Cementitious Paint	CEP (TT-P-1411)
Exterior Latex	EL??(MPI 10 / 11 / 119)??
Exterior Oil	EO (MPI 9 - gloss/MPI 8 - flat/MPI 94 - semigloss)
Epoxy Coating	EC (MPI 77 - walls, floors/MPI 108 - CMU, concrete)
Fire Retardant Paint	FR (MPI 67)
Fire Retardant Coating (Clear)	FC (MPI 66, intumescent type)
Floor Enamel	FE (MPI 27 - gloss/MPI 59 - eggshell)
Heat Resistant Paint	HR (MPI 22)
Latex Emulsion	LE (MPI 53, flat/MPI 52, eggshell/MPI 54, semigloss/MPI 114, gloss Level 6)
Latex Flat	LF (MPI 138)
Latex Gloss	LG (MPI 114)
Latex Semigloss	SG (MPI 141)
Latex Low Luster	LL (MPI 139)
Plastic Floor Coating	PL
Polyurethane Varnish	PV (MPI 31 - gloss/MPI 71 - flat)
Rubber Paint	RF (CID-A-A-3120 - Paint for Swimming Pools (RF)).
Water Paint, Cement	WPC (CID-A-A-1555 - Water Paint, Powder).
Wood Stain	WS (MPI 90)

Verify abbreviations used in the following coating sections:

Section 09 96 59, HIGH-BUILD GLAZED COATINGS	GC
Section 09 94 19, MULTICOLOR INTERIOR FINISHING	MC

END OF APPENDIX

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies interior signage for room numbers, directional signs, code required signs, telephone identification signs and temporary interior signs.
- B. Match the existing signage as closely as practicable.

1.2 RELATED WORK

- A. Color Finish: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 MANUFACTURER'S QUALIFICATIONS

Sign manufacturer shall provide evidence that they regularly and presently manufactures signs similar to those specified in this section as one of their principal products.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 00, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples: Sign panels and frames, with letters and symbols, each type. Submit 2 sets. One set of samples will be retained by Project Engineer, other returned to Contractor.
 - 1. Color samples of each color, not less than 150 mm x 150 mm (6 inches x 6 inches. Show anticipated range of color and texture.
 - 2. Sample of typeface, arrow and symbols in a typical full size layout.
- C. Manufacturer's Literature:
 - 1. Showing the methods and procedures proposed for the concealed anchorage of the signage system to each surface type.
 - 2. Manufacturer's printed specifications, anchorage details, installation and maintenance instructions.
- D. Samples: Sign location plan, showing location, type and total number of signs required.
- E. Shop Drawings: Scaled for manufacture and fabrication of sign types. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes. Submit a Sign Message Schedule.
- F. Full size layout patterns for dimensional letters.

1.5 DELIVERY AND STORAGE

- A. Deliver materials to job in manufacturer's original sealed containers with brand name marked thereon. Protect materials from damage.
- B. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.
- C. Deliver signs only when the site and mounting services are ready for installation work to proceed.
- D. Store products in dry condition inside enclosed facilities.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate
 - B221-06.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and tubes.
- C. Federal Specifications (Fed Spec):
 - MIL-PRF-8184F.....Plastic Sheet, Acrylic, Modified.
 - MIL-P-46144C.....Plastic Sheet, Polycarbonate

1.7 MINIMUM SIGN REQUIREMENTS

- A. Permanent Rooms and Spaces: Match the existing signs.
 - 1. Tactile and Braille Characters, raised minimum 0.793 mm (1/32 in). Characters shall be accompanied by Grade 2 Braille.
 - 2. Type Styles: Characters shall be uppercase, Helvetica Medium, Helvetica Medium Condensed and Helvetica Regular.
 - 3. Character Height: Minimum 16 mm (5/8 in) high, Maximum 50 mm (2 in).
 - 4. Symbols (Pictograms): Equivalent written description shall be placed directly below symbol, outside of symbol's background field. Border dimensions of symbol background shall be minimum 150 mm (6 in) high.
 - 5. Finish and Contrast: Characters and background shall be eggshell, matte or other non-glare finish with adequate contrast with background.
 - 6. Mounting Location and Height: As shown. Mounted on wall adjacent to the latch side of the door and to avoid door swing and protruding objects.

B. Overhead Signs:

1. Type Styles: As shown. Characters shall have a width-to-height ratio between 3:5 and 1:1. Characters shall have a stroke width-to-height ratio of between 1:5 and 1:10.
2. Character Height: minimum 75 mm (3 in) high for overhead signs. As shown, for directional signs.
3. Finish and Contrast: Same as for signs of permanent rooms and spaces.
4. Mounting Location and Height: As shown.

1.8 COLORS AND FINISHES:

Section 09 06 00, SCHEDULE FOR FINISHES.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Subject to compliance with specified requirements, and review of SUBMITTALS by the Architect, signs shall be the product of one of the following:
1. Allenite Signs; Allen Marking Products, Inc.
 2. American Graphics Inc.
 3. Andco Industries Corp.
 4. APCO Graphics, Inc.
 5. ASI Sign Systems, Inc.
 6. Best Manufacturing Co.
 7. Mills Manufacturing, Inc.
 8. Mohawk Sign Systems.
 9. Seton Identification Products.
 10. Signs and Lucite Products
- B. Signs of type, size and design shown on the drawings and as specified.
- C. Signs complete with lettering, framing and related components for a complete installation.
- D. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.
- E. Do not scale drawings for dimensions. Contractor to verify and be responsible for all dimensions and conditions shown by these drawings. Resident Engineer to be notified of any discrepancy in drawing, in field directions or conditions, and/or of any changes required for all such construction details.
- F. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. The Contractor shall further warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.

2.2 PRODUCTS

- A. Aluminum:
 - 1. Sheet and Plate: ASTM B209.
 - 2. Extrusions and Tubing: ASTM B221.
- B. Cast Acrylic Sheet: MIL-PRF-8184F; Type II, class 1, Water white non-glare optically clear. Matt finish water white clear acrylic shall not be acceptable.
- C. Polycarbonate: MIL-P-46144C; Type I, class 1.
- D. Vinyl: 0.1 mm thick machine cut, having a pressure sensitive adhesive and integral colors.

2.3 SIGN STANDARDS

- A. Topography: Match existing styles, lettering, and graphics.
 - 1. Type Style: Initial caps or all caps as indicated in Sign Message Schedule.
 - 2. Arrow: See graphic standards in drawings.
 - 3. Letter spacing: See graphic standards on drawings.
 - 4. Letter spacing: See graphic standards on drawings.
 - 5. All text, arrows, and symbols to be provided in size, colors, typefaces and letter spacing shown. Text shall be a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings are for layout purposes only; final text for signs is listed in Sign Message Schedule.
- B. Project Colors and Finishes: See Section 09 06 00, SCHEDULE FOR FINISHES.

2.4 TEMPORARY INTERIOR SIGNS

- A. Fabricated from 50 kg (110 pound) matte finished white paper cut to 100 mm (4 inch) wide by 300 mm (12 inch) long. Punched 3 mm (.125 inch) hole with edge of hole spaced 13 mm (.5 inch) in from edge and centered on 100 mm (4 inch) side. Reinforce hole on both sides with suitable material that prevents tie from pulling through hole. Ties are steel wire 0.3 mm (0.120 inch) thick attached to tag with twist leaving 150 mm (6 inch) long free ends.
- B. Mark architectural room number on sign, with broad felt marker in clearly legible numbers or letters that identify room, corridor or space as shown on floor plans.
- C. Install temporary signs to all rooms that have a room, corridor or space number. Attach to door frame, door knob or door pull.
 - 1. Doors that do not require signs are: corridor doors in corridor with same number, folding doors or partitions, toilet doors, bathroom doors within and between rooms,

closet doors within rooms, communicating doors in partitions between rooms with corridor entrance doors.

2. Replace and missing damaged or illegible signs.

2.5 FABRICATION

- A. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.
- B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
- C. Shop fabricate so far as practicable. Joints fastened flush to conceal reinforcement, or welded where thickness or section permits.
- D. Contact surfaces of connected members be true. Assembled so joints will be tight and practically unnoticeable, without use of filling compound.
- E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces be smooth flat and without oil-canning, free of rack and twist. Maximum variation from plane of surface plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.
- F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth sulrfaces.
- G. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.
- H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.
- I. Finish hollow signs with matching material on all faces, tops, bottoms and ends. Edge joints tightly mitered to give appearance of solid material.
- J. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.
- K. Movable parts, including hardware, are be cleaned and adjusted to operate as designed without binding or deformation of members. Doors and covers centered in opening or frame. All contact surfaces fit tight and even without forcing or warping components.
- L. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

- M. No signs are to be manufactured until final sign message schedule and location review has been completed by the Resident Engineer & forwarded to contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Protect products against damage during field handling and installation. Protect adjacent existing and newly placed construction, landscaping and finishes as necessary to prevent damage during installation. Paint and touch up any exposed fasteners and connecting hardware to match color and finish of surrounding surface.
- B. Mount signs in proper alignment, level and plumb according to the sign location plan and the dimensions given on elevation and sign location drawings. Where otherwise not dimensioned, signs shall be installed where best suited to provide a consistent appearance throughout the project. When exact position, angle, height or location is in doubt, contact Resident Engineer for clarification.
- C. Contractor shall be responsible for all signs that are damaged, lost or stolen while materials are on the job site and up until the completion and final acceptance of the job.
- D. Remove or correct signs or installation work Resident Engineer determines as unsafe or as an unsafe condition.
- E. At completion of sign installation, clean exposed sign surfaces. Clean and repair any adjoining surfaces and landscaping that became soiled or damaged as a result of installation of signs.
- F. Locate signs as shown on the Sign Location Plans.
- G. Certain signs may be installed on glass. A blank glass back up is required to be placed on opposite side of glass exactly behind sign being installed. This blank glass back up is to be the same size as sign being installed.
- H. Contractor will be responsible for verifying that behind each sign location there are no utility lines that will be affected by installation of signs. Any damage during installation of signs to utilities will be the sole responsibility of the Contractor to correct and repair.
- I. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices which may involve other trades.

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SECTION 10 21 13

TOILET COMPARTMENTS (TBD)

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies metal toilet partitions as indicated on the drawings, To Be Determined (TBD).

1.2 RELATED WORK

- A. Overhead structural steel supports for ceiling hung pilasters: Section 05 50 00, METAL FABRICATIONS.
- B. Color of baked enamel finish: Section 09 06 00, COLOR AND DESIGN.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: Prime coat of paint on 150 mm (six-inch) square of metal panel with baked enamel finish coat over half of panel.
- C. Manufacturer's Literature and Data: Specified items indicating all hardware and fittings, material, finish, and latching.
- D. Shop Drawings: Construction details at 1/2 scale, showing installation details, anchoring and leveling devices.
- E. Manufacturer's certificate, attesting that zinc-coatings conform to specified requirements.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
FF-B-575C.....Bolt, Hexagon and Square
- C. Code of Federal Regulations (CFR):
40 CFR 247.....Comprehensive Procurement Guidelines for
Products Containing Recovered Materials
- D. Commercial Item Descriptions (CID):
A-A-1925.....Shield, Expansion (Nail Anchors)
A-A-60003.....Partitions, Toilet, Complete

PART 2 - PRODUCTS

2.1 METAL TOILET PARTITIONS

- A. Subject to compliance with specified requirements, metal toilet partitions shall be the product indicated on the drawings.

- B. Conform to Fed. CID A-A-60003, except as modified herein.
- C. Fabricate to dimensions shown or specified.
- D. Toilet Enclosures:
 - 1. Type 1, Style A (Floor supported), and C (overhead braced).
 - 2. Reinforce panels shown to receive toilet tissue holders or grab bars.
 - 3. Upper pivots and lower hinges adjustable to hold doors open 30 degrees.
 - 4. Latching devices and hinges for handicap compartments shall comply with ADA requirements.
 - 5. Keeper:
 - a. U-slot to engage bar of throw latch.
 - b. Combined with rubber bumper stop.
 - 6. Wheelchair Toilets:
 - a. Upper pivots and lower hinges to hold out swinging doors in closed position.
 - b. Provide U-type doors pulls, approximately 100 mm (four inches) long on pull side.
 - 7. Finish: Finish 1 (baked enamel) on steel doors, pilasters, and enclosure panels except those adjacent to urinals and as specified.
- E. Urinal Screens:
 - 1. Type III, Style D (wall hung), finish 3, and (stainless steel).
 - a. With integral flanges and continuous, full height wall anchor plate.
 - b. Option: Full height U-Type bracket.
 - c. Wall anchor plate drilled for 4 anchors on both sides of screen.
 - 2. Screen 600 mm (24 inches) wide and 1060 mm (42 inches high).

2.2 FASTENERS

- A. Partition Fasteners: CID A-A-60003.
- B. Use expansion bolts, CID A-A-60003, for anchoring to solid masonry or concrete.
- C. Use toggle bolts, CID A-A-60003, for anchoring to hollow masonry or stud framed walls.
- D. Use steel bolts FS-B-575, for anchoring pilasters to overhead steel supports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install in rigid manner, straight, plumb and with all horizontal lines level.
2. Conceal evidence of drilling, cutting and fitting in finish work.
3. Use hex-bolts for through-bolting.
4. Adjust hardware and leave in freely working order.
5. Clean finished surfaces and leave free of imperfections.

B. Panels and Pilasters:

1. Support panels, except urinal screens, and pilaster abutting building walls near top and bottom by stirrup supports secured to partitions with through-bolts.
2. Secure stirrups to walls with two suitable anchoring devices for each stirrup.
3. Secure panels to faces of pilaster near top and bottom with stirrup supports, through-bolted to panels and machine screwed to each pilaster.
4. Secure edges of panels to edges of pilasters near top and bottom with "U" shaped brackets.
5. Where overhead braced, secure pilasters to building walls by headrails clamped on or set into top of each pilaster.
 - a. Secure clamps to pilasters with two through-bolts to each clamp.
 - b. When headrails are set into pilasters, through-bolt them to the pilasters.
 - c. Support headrails on wall flange fittings secured to building walls with minimum of two anchor bolts to each flange fitting.

C. Urinal Screens:

1. Anchor urinal screen flange to walls with minimum of four bolts both side of panel.
2. Space anchors at top and bottom and equally in between.

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SECTION 10 21 23

CUBICLE CURTAIN TRACKS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies cubicle curtain track (C.C.T.) and intravenous support assembly (I.V), as indicated on the drawings.

1.2 RELATED WORK

Steel shapes for suspending track assembly: Section 05 50 00, METAL FABRICATIONS and 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. Samples:
 - 1. One 300 mm (12 inch) long piece of cubicle curtain track with carrier access and end stop.
 - 2. One clip anchor for fastening track to grid system of acoustical ceilings. One curtain carrier.
 - 3. One intravenous support assembly consisting 300 mm (12 inch) long pieces of track, carrier assembly, and bottle pendant.
- C. Shop Drawings: Showing layout of tracks and method of anchorage.
- D. Manufacturer's Literature and Data:
 - 1. Cubicle curtain track.
 - 2. Intravenous support assembly.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver material in original package marked to identify the contents, brand name, and the name of the manufacturer or supplier.
- B. Store in dry and protected location. Store so as to not bend or warp the tracks.
- C. Do not open packages until contents are needed for installation, unless verification inspection is required.

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):
 - B221-06.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
 - B456-03.....Electrodeposited Coatings for Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
- C. The National Association of Architectural Metal Manufacturers (NAAMM):
 - AMP 500 Series....Metal Finishes Manual

PART 2 - PRODUCTS

2.1 CUBICLE CURTAIN TRACKS

- A. Surface mounted or suspended type:
 - 1. Channel Tracks (Surface Mounted Type): Extruded aluminum, ASTM B221, alloy 6063, temper T5 or T6, channel shaped, with smooth inside raceway for curtain carriers.
 - 2. Tubular Track (Suspended Type): Seamless drawn aluminum tubing, ASTM B221, alloy 6061 temper T6, 25 mm (one inch) outside diameter, not less than 1.5 mm (0.060 inch) wall thickness, slotted for interior carriers.
- B. Curtain Carriers: Nylon or delrin carriers, with either nylon or delrin wheels on metal, delrin, or nylon axles. Equip each carrier with either stainless steel, chromium plated brass or steel hooks with swivel, or nickel chromium plated brass or stainless steel bead chain and hook assembly, or delrin carriers may have moulded on delrin hooks. Hook for bead chain may be the same material and finish as the bead chain or may be chromium plated steel. Provide 2.2 carriers for every 300 mm (onefoot) of each section of each track length, plus one additional carrier.
- C. End Stop Connectors, Ceiling Flanges and Other Accessories: Fabricate from the same material with the same finish as the tracks or from nylon.
- D. Hangers and Fittings: Fabricate from the same material with the same finish as the tracks. Hangers may be round or square for channel tracks and round for tubular tracks. Design fittings to be compatible with design of tracks and to safely transmit the track load to the hangers.
- E. At end of each section of track, make provision for insertion and removal of carriers. Design to prevent accidental removal of carrier. Any operating mechanism shall be removable with common tools.

2.2 INTRAVENOUS SUPPORT ASSEMBLY

- A. Assembly includes track, carrier assembly, bottle holding pendant, curved track sections and curved connectors, and all components and accessories required for a working installation.

- B. Track: Surface mounted channel or "I" beam shaped, extruded aluminum. Equip track with removable section at splicing clamp for carrier removal. Overall size of track shall be as shown on drawings.
- C. Carrier Assembly: Assembly shall include a body made of either stainless steel or aluminum, and be equipped with four ball bearing nylon wheels and lockstop to ensure insulation of carrier from track. Equip carrier with a positive locking device to hold carrier stationary when in use. Provide with either a stainless steel, or chromium plated brass hook for support of bottle holding pendent.
- D. Bottle Holding Pendent: Equip with a minimum of three, stainless steel, chromium plated steel, or chromium plated brass arms connected to adjustable shaft of same material. Adjustable shaft shall permit bottle holding hub to adjust from full height to approximately 1800 mm (six feet), 75 mm (three inches) above finished floor. Provide shaft with a built-in locking device for vertical height adjustments. Locking device shall be activated by push button or similar easily operated one hand control.

2.3 FASTENERS

- A. Exposed Fasteners, Screws and Bolts: Stainless steel or chromium/nickel plated brass.
- B. Concealed Fasteners, Screws and Bolts: Hot-dip galvanized (except in high moisture areas use stainless steel).
- C. Metal Clips: Anchor curtain tracks to exposed grid of lay-in acoustical tile ceilings, with concealed metal (butterfly) type or two piece snap locking type ceiling clip of high strength spring steel. When it is not possible to install the metal ceiling clip, the cubicle curtain track may be screwed to the ceiling grid.

2.4 FINISHES

- A. Aluminum: Chemically etched medium matte, with clear anodic coating, Class II Architectural, 0.4 mils thick.
- B. Chrome/Nickel Plating: Satin or polished finish as specified, ASTM B546, minimum thickness of chromium plate as follows:
 - 1. 0.2 mil on copper alloys.
 - 2. 0.4 mil on steel.
- C. Stainless Steel: No. 4 in accordance with NAAMM Metal Finishes Manual.

2.5 FABRICATION

- A. Weld and grind smooth joints of fabricated components.
- B. Form tracks and bends of lengths that will produce the minimum number of joints. Make track sections up to 4800 mm (16 feet) without joints. Form corner bend on a 300 mm (12 inch) radius.
- C. Provide steel anchor plates, supports, and anchors for securing components to building construction.

- D. Form flat surface without distortion.
- E. Shop assemble components and package complete with anchors and fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install tracks after finish painting and ceiling finishing operations are complete.
- B. Install track level and hangers plumb and securely anchor to the ceiling or suspend from above to form a rigid installation.
- C. Anchor surface mounted curtain tracks directly to exposed grid of lay-in acoustical tile ceilings with suitable fasteners, spaced approximately 600 mm (24 inches) on center.
- D. Anchor surface mounted curtain tracks to concrete, plaster and gypsum board ceilings with a minimum of 3 mm (1/8-inch) diameter fastenings or concealed clips spaced not more than 900 mm (three feet) on center.
- E. Install suspended track seven feet, three inches above the finished floor, with hangers spaced no more than four feet on center. At ceiling line, provide flange fittings secured to hangers with set screws. Secure track to walls with flanged fittings and to hangers with special fittings.
- F. Securely fasten end stop caps to prevent their being forced out by the striking weight of carriers.
- G. Anchor surface mounted intravenous track directly to support system above ceiling as shown.
- H. Remove damaged or defective components and replace with new components or repair to the original condition.

3.2 ACCEPTANCE

- A. Track shall be installed neat, rigid, plumb, level and true, and securely anchored to the overhead construction.
- B. Carrier units shall operate smoothly and easily over the full range of travel.

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SECTION 10 26 00

WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies wall guards and corner guards and door/door frame protectors where indicated on the drawings.

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: Section 09
06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Show design and installation details.
- C. Manufacturer's Literature and Data:
 - 1. Wall Guards.
 - 2. Corner Guards.
- 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 21° C (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(R2004).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

- B221-07.....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
- E84-07.....Surface Burning Characteristics of
Building Materials
- C. The National Association of Architectural Metal Manufacturers
(NAAMM):
- AMP 500 Series.....Metal Finishes Manual
- D. National Fire Protection Association (NFPA):
- 80-06.....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 WALL AND DOOR PROTECTION

- A. Subject to compliance with specified requirements, wall protection and corner guards shall be "Acrovyn" by Construction Specialties Inc., or an "or equal" product by one of the following:
1. American Floor Products Co., Inc.
 2. ARDEN Architectural Specialties, Inc.
 3. Balco, Inc.
 4. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 5. Pawling Corporation
- B. Stainless Steel: ASTM A167, Type 302B.
- C. 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. //
- D. Resilient Material:
1. Extruded and injection molded acrylic vinyl or extruded polyvinyl chloride meeting following requirements:

- a. Minimum impact resistance of 1197 ps (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.
- E. Coordinate wall and door protection material to ensure fit for all components, and color as specified.
- F. Provide adhesive as recommended by the material manufacturer.

2.2 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.

2.3 FINISH

- A. In accordance with NAAMM AMP 500 series, and as selected by the Architect.
- B. Aluminum:
 - 1. Exposed aluminum: AAC22A31 chemically etched medium matte, with clear anodic coating, Class II Architectural, 0.4 mil thick, or AA-C22A32 chemically etched medium matte with integrally colored 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. Stainless Steel: NAAMM finish Number 4.
- D. Resilient Material: Embossed texture and color in accordance with SAE J 1545 and as specified in Section 09 06 00, SCHEDULE FOR FINISHES.

PART 3 - INSTALLATION

3.1 CORNER GUARDS AND DOOR PROTECTION

- A. Install corner guards and door protection in accordance with manufacturer's instructions.
 - 1. Where corner guards are installed on gypsum board, clean surface and anchor guards with a neoprene solvent-type contact adhesive specifically manufactured for use on gypsum board construction. Remove excess adhesive from around edge of guard and allow to cure undisturbed for 24 hours.

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SECTION 10 28 00

TOILET ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

This section covers toilet accessories including mirrors, grab bars, dispensers and similar prefabricated items usually used in dressing rooms, toilets, and similar spaces.

1.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by Bobrick Washroom Equipment, Inc., or "or equal products of one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bradley Corporation.
4. General Accessory Manufacturing Co. (GAMCO).

B. Accessories shall be products of manufacturers regularly engaged in manufacturing items of type specified.

1.3 IDENTICAL ACCESSORIES

Each different accessory of the same type shall be identical, and be the product of one manufacturer.

1.4 SUBMITTALS

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

B. Shop Drawings:

Paper towel dispenser and disposal combination units and wheelchair mirrors, showing design and installation of units when installed on offset surfaces.

Metal framed mirrors, showing fillers and shelf where required.

Grab bars, showing design and each different type of anchorage.

C. Manufacturer's Literature and Data:
All accessories. Literature shall show type of material, gages and finishes and when required, capacity of accessories.

1.5 PACKAGING

Pack accessories individually to protect accessory and its finish.

1.6 DELIVERY

Deliver accessories to the project only when installation work in rooms is ready to receive them.

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. Federal Specifications (Fed. Specs.):
- DD-G-451D.....Glass, Float or Plate, Sheet, Figured
(Flat For Glazing, Mirrors And Other Uses)
- DD-G-1403B(1).....Glass, Plate (Float), Sheet, Figured, and
Spandrel (Heat Strengthened and Fully
Tempered)
- WW-P-541/8.....Plumbing Fixtures (Accessories, Land Use)
- C. American Society For Testing and Materials (ASTM):
- A167-82.....Stainless and Heat-Resisting Chromium-
Nickel Steel Plate, Sheet and Strip.
- A176-82.....Stainless and Heat-Resisting Chromium
Steel Plate, Sheet, and Strip
- A268-79a.....Seamless and Welded Ferritic Stainless
Steel Tubing for General Service
- A366-72(1979).....Cold-Rolled Carbon Steel Sheets,
Commercial Quality
- B221-83.....Aluminum-Alloy Extruded Bars, Rods, Wire,
Shapes, and Tubes
- B456-79.....Electrodeposited Coatings of Copper Plus
Nickel Plus Chromium and Nickel Plus
Chromium
- D635-81.....Rate of Burning and/or Extent and Time of
Burning of Self Supporting Plastics in a
Horizontal Position
- D. The Aluminum Association (AA):
- Designation System for Aluminum Finishes (March 1973)
- E. The National Association of Architectural Metal Manufacturers
(NAAMM):
- Metal Finishes (August 1969)

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: ASTM B221, alloy 6063-T5 and alloy 6463-T5.
- B. Glass:
1. Fed. Spec. DD-G-451, Type I, Class 1, Quality q1, for mirrors.
- C. Steel Sheet: ASTM A526, zinc-coated (galvanized), coating designation G90.

- D. Stainless Steel: ASTM A167, Type 302, 304, or 304L, except ASTM A176 where Type 430 is specified, 0.0299 inch thick unless otherwise specified.

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 use stainless steel).
- C. Expansion Shields: Lead or plastic as recommended by accessory manufacturer for component and substrate.

2.3 FINISH

- A. Aluminum
 - 1. AA-A31 - Clear anodic coating, Class II Architectural, 0.4 mils thick.
 - 2. AA-A41 - Clear anodic coating, Class I Architectural, 0.7 mils thick.
- B. Chromium Plating: ASTM B456, satin or bright as specified, Service Condition No. SC2.
- C. Stainless Steel: NAAMM Finish No. 4.
- D. Ferrous Metal:
 - 1. Shop Prime: Clean, pretreat and apply one coat of primer and bake.
 - 2. Finish: Over primer apply two coats of alkyd or phenolic resin enamel, and bake.
- E. 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

- A. Grind and finish welded joints to match finish of adjacent surface.
- B. Form exposed surfaces from one sheet of stock, free of joints.
- C. Provide steel anchors and components required for secure installation.
- D. Form flat surfaces without distortion. Keep exposed surfaces free from scratches and dents. Reinforce doors to prevent warp or twist.
- E. Isolate aluminum from dissimilar metals and from contact with building materials as required to prevent electrolysis and corrosion.

- F. Hot-dip galvanized steel (except stainless steel) anchors and fastening devices.
- G. Shop assemble accessories and package with all components, anchors, fittings, fasteners and keys.

2.5 PAPER TOWEL DISPENSER AND DISPOSAL COMBINATION UNITS

- A. Recessed type, having a capacity for dispensing 400 sheets of any type of paper toweling.
- B. Where recessed type units are shown, provide top, side and bottom collar fabricated of the same material and finish as front.
- C. Fabricate of stainless steel. Form face frames, from one piece.
- D. Provide each door with continuous stainless steel piano hinge and tumbler non keyed lock.
- E. Provide removable waste receptacle of approximately 1.3 cubic feet (10.5 gallon) capacity, fabricated of 0.018 inch thick stainless steel.

2.6 SOAP DISPENSER, LIQUID WALL MOUNTED

- A. Bottom mounted plunger type dispensers and dispensers having glass soap containers are not acceptable.
- B. Horizontal Soap Valve: Acrylic Hard Plastic housing with cylinder and piston, that dispenses one-milliliter metered flow of liquid with each depression of the plunger, clears and self cleans out any soap remaining in spout by return stroke of the valve, preventing congealing of soap in the spout.
- C. Provide units with concealed mounting plates that discourage tampering with units, but assures ease in installation and maintenance removal.

2.7 GRAB BARS

- A. Concealed mount, except grab bars mounted at floor and on metal partitions. Fabricate of stainless steel: use only one type throughout the projects:
 - 1. Stainless Steel: Grab bars, flanges, mounting plates, supports, screws, bolts, and exposed nuts and washers.
- B. Bars: Fabricate from 1-1/2 inch outside diameter tubing with walls not less than 0.0478 inch thick for stainless steel, and not less than 0.0598 inch thick for nylon coated bars. Fabricate in one continuous piece with ends turned toward walls, except where grab bars are shown continuous around three sides of showers, bars may be fabricated in two section, with concealed slip joint between.
- C. Intermediate Supports: Continuous weld intermediate support to the grab bar and grind welds smooth.
- D. Flange for Exposed Mounting: Not less than 3/16-inch thick, approximately 3-inch diameter. Insert grab bar through flange and continuously weld perimeter of grab bar flush to backside of flange.

1. Where mounted on walls and showers partitions, provide three equally spaced, countersunk holes, sized to accommodate 3/16-inch diameter bolts.
 2. Where mounted on floor, provide four equally spaced holes, sized to accommodate 3/8-inch diameter bolts, not more than 3/8-inch from edge of flange.
- E. Flange for Concealed Mounting: Not less than 0.1046 inch thick, approximately 3-inch diameter by 1/2-inch deep, with provisions for not less than three set screws for securing flange to back plate. Insert grab bar through center of the flange and continuously weld perimeter of grab bar flush to back side of flange.
- F. Back Plates: Fabricate from not less than 0.1046 inch thick metal, in one piece, approximately 1/4-inch deep, with diameter sized to suit flange. Provide slotted holes to accommodate anchor bolts.
- 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. Furnish spreaders, through bolt fasteners, and cap nuts, where grab bars are mounted on metal partitions.

2.8 METAL FRAMED MIRRORS

- A. Mirror Glass: Minimum 1/4-inch thick with chemically deposited silvering, copper plating, and tough elastic paint or varnish coating. Set mirror in a protective vinyl glazing tape.
- B. Frames: Channel or angle shaped section with face of frame not less than 3/8-inch wide, constructed of either 0.0359 thick stainless steel with clear anodized finish 0.4 mils thick.
- C. Filler: Fabricate fillers from same material and finish as the mirror frame, tapered and contoured to conceal slant mirror void.
1. Provide fillers to close top and sides of slanted mirrors mounted above wheelchair lavatories.
 2. Where mirrors are mounted on walls having FRP wainscots not flush with wall above, provide fillers at void between back of mirror and wall surface.
- D. Back Plate: 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.
- E. Shelf for Mirrors: Fabricated shelf of the same material and finish as the mirror frame. Form shelf for stainless steel framed mirror to be an integral part of the bottom frame member. Make shelf approximately five inches in depth, and extend full width of the mirror. Close the ends and the front edge of the shelf to the same thickness as the mirror frame width.

2.9 TOILET TISSUE DISPENSERS

- A. Surface mounted type, Fed. Spec. WW-P-541/8 single roll, Style B, Kind C with removable spindle except zinc alloy and plastic dispensers and wood rollers are not acceptable.
- B. Recessed type, having a capacity for dispensing double roll vertical toilet paper, and seat covering box with top access. Finish to be 302 stainless steel.

2.10 TOWEL BARS

- A. Towel bars; Fed. Spec. WW-P541/8, stainless steel.
- B. Length: 18 and 24 inches in length.
- C. Finish of bar same as brackets.

2.11 CLOTHES HOOKS

- A. Fabricate hook units of 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 TOILET SEAT COVER DISPENSERS

- A. Provide Type 304 stainless steel with surface mounted toilet seat cover dispensers. Provide dispenser with a minimum capacity of 500 seat covers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Deliver inserts and rough-in frames to jobsite at appropriate time for building-in. Provide templates and rough-in measurements as required.
- B. Before starting work notify Project Engineer in writing of any conflicts detrimental to installation or operation of units.
- C. Verify with the Project Engineer the exact location of accessories.

3.2 INSTALLATION

- A. Install accessories in accordance with the manufacturer's printed instructions.
- B. Install accessories plumb and level and securely anchor to substrate.
- C. 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.
- D. Align mirrors, dispensers and other accessories even and level.

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SECTION 10 44 13

FIRE EXTINGUISHERS CABINETS

PART 1 - GENERAL

1.1 DESCRIPTION:

This section covers recessed fire extinguisher cabinets and fire extinguishers.

1.2 SUBMITTALS:

In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, furnish the following:

- A. Manufacturer's Literature and Data: Fire extinguisher cabinet including installation instructions and rough opening requirements.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHER CABINETS

- A. Due to standards enforced by local authority extinguisher type to be: Model No. 1017F12 W/ADAC by "J.L. Industries" or equal as approved by the Hospital Safety Engineer.

2.2 FIRE EXTINGUISHERS

- A. Multi-purpose type Dry Chemical complying with UL 299 and Rated 4A-60B:C when tested in accordance with UL 711. The extinguisher shall be 10 lbs. Maximum, diameter not greater than 5.5 inches.

2.3 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. Glaze doors with 1/4-inch thick clear acrylic.
- C. Design doors to open 180 degrees. Provide continuous hinge, pull handle and adjustable roller catch.

2.4 FINISH

- A. Finish interior of cabinet and body with baked-on semi-gloss white enamel.

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 40 inches above finished floor.

- - - E N D - - -

SECTION 12 23 17

CUBICLE CURTAINS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install cubicle curtains as indicated on the drawings and specified.

1.2 STANDARDS

- A. comply with the following standards:
 - 1. Uniform Building Code (UBC) Standards with State of California Amendments.
 - 2. International Organization for Standardizations (ISO).
 - 3. National Fire Protection Association (NFPA).
 - 4. Occupational Safety and Health Administration (OSHA).
 - 5. Underwriters Laboratories Inc. (UL) Standards for Safety

1.3 SUBMITTALS

- A. Submit catalog or data sheets for components parts indicating compliance with the contract documents.
- B. Samples, submit the following for approval:
 - 1. Full bolt width (54") by 36-inch sample of each fabric and color
 - 2. 24" by 24" sample showing each top and bottom hem finish at curtains.

1.4 WARRANTY

- A. The warranty period shall be 2 years. During the warranty period, repair or replace faulty items within 14 calendar days of notice of failure.

PART 2 - PRODUCTS

2.1 CUBICLE CURTAINS

- A. Subject to compliance with specified requirements, cubicle curtains shall be "Increment Pattern, 511443 Product Number, 004 Frame" by Maraham, or an "or equal" product by one of the following:
 - 1. Architex
 - 2. Design Tex

3. Carnegie

B. Fabric, Accessories and Fabrication

1. General

- a. Fabric panels shall be constructed to best trade practices.
- b. Fabric cuts shall be full height without splices
- c. Seconds and re-dyed fabrics are not acceptable.
- d. Fabric shall be vat-dyed (unless specified to have natural color) and free of streaking, spotting or other variations in color or pigment impregnation.
- e. Fabric shall be free of wrinkles, crush marks, nap irregularities and other anomalous markings.
- f. Puckered seams are not acceptable.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install cubicle curtains as recommended by the product manufacturer.

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SECTION 12 31 00

METAL CASEWORK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section covers the installation of metal casework and prefinished countertops.

1.2 QUALIFICATIONS

- A. Approval of Contracting Officer is required of products or services of proposed manufacturer, supplier and installer.
- B. Approval will be base on submission by Contractor certification that:
 - 1. Manufacturer regularly and presently manufactures Metal Casework as one of its principal products.
 - 2. Installer has the technical qualifications, experience, trained personnel and facilities to install specified item.
 - 3. Manufacturer's product submitted has been in satisfactory and efficient operation on three installations similar to this project for approximately three years. Submit list of installations.
 - 4. There is a permanent service organization maintained or trained by manufacturer which will render satisfactory service within 24 hours of receipt of notification that service is needed.

1.3 MANUFACTURED PRODUCTS

- A. Materials, fixtures and equipment furnished shall be of the current production of manufacturers regularly engaged in the manufacture of such items.
- B. When two of more units are required, they shall be products of the same manufacturer.
- C. Manufacturer of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 1. Components of an assembled unit need not be the products of a single manufacturer.
 - 2. Constituent parts which are alike shall be the products of a single manufacturer.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.

1.4 SUBMITTALS

- A. Before executing any work, submit in accordance with Section 01340, SAMPLES AND SHOP DRAWINGS.

B. Certificates:

1. Manufacturer regularly and presently manufactures proposed metal casework as a principal product.
2. Installer has technical qualifications, experience and trained personnel, and facilities to install equipment specified.
3. Name and address of service organization.

C. Manufacturer's Literature and Data:

1. Brochures showing name and address of manufacturer, and catalog or model number of each item incorporated into the work.
2. Manufacturer's illustration and detailed description.
3. List of deviations from Contract Specifications.

D. Samples: One completely assembly, including countertop, cabinet with drawers.

E. Shop Drawings: Items specially fabricated.

F. Installation Drawings: Show dimensions, method of assembly, installation and conditions relating to adjoining work which requires cutting or close fitting, reinforcing, anchorage and other work required for complete installation.

1.5 REFERENCED SPECIFICATIONS AND PUBLICATIONS

- A. Conformance to Agency Requirements: Where an item is required by reference specification of publication to conform to certain requirements of any agency or establishment, conformance shall be evidenced by seal, label, stamp, or approval listing from such agency, or by a certified test report from an independent testing laboratory acceptable to the Government, and that the item has been tested and conforms to the requirements of the referenced agency.

1.6 APPLICABLE PUBLICATION

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

- B. Federal Specifications (Fed. Spec.)

QQ-S-698(3).....Steel, Sheet and Strip, Low Carbon

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Sheet Steel: Fed. Spec. QQ-S-698 cold rolled, commercial quality sheet steel.

1. Thickness:

0.035 Inch: Drawer fronts, backs bodies, door panels, scribe and filler strips less than three inches wide, and shelf reinforcement channels and shelves.

0.047 Inch: Base pedestals, top, sides, back and bottom panels, scribe and filler strips three inches or more. Drawer runners door tracks.

0.059 Inch: Aprons, apron division, reinforcing gussets, spreaders and stretchers when formed without welding, drawer slides and other metal work.

0.104 Inch: Base unit bottom corner gussets.

B. Hardware:

1. Hinges: Hospital type, steel or brass, 5 knuckle, 2-1/2 inch size.
2. Sheaves: Cadmium plated hardened steel, ball bearing or oilite bearing, operating on fiber, nylon, resin plastic or steel track.
3. Catches: Nylon roller catch.
4. Pulls: Drawer or hinged door, cast, forged or extruded metal or metal reinforced plastic bar.
5. Drawer Slides: Ball bearing or nylon roller suspension type with positive stop.
6. Silencers: Rubber, two each single leaf door jamb, one at head of frame for each leaf or pair doors.

C. Base Molding: Molded top set, 6 inches high with cove bottom and formed corners as specified in Division 9.

D. Baked Enamel: Baked enamel shall resist action of the following reagents applied as one ml puddle each surface for a period of one hour.

Phosphoric Acid	75%
Sulfuric Acid	25%
Glacial Acetic Acid	
Sodium Hydroxide	10%
Sodium Hydroxide	25%
Ammonia Hydroxide	(conc)
Hydrogen Peroxide	5%
Phenol	85%
Formaldehyde	37%

E. Molded Epoxy Resin: Molded Epoxy Resin tops shall be molded from a modified epoxy resin. Tops and curbs shall be uniform mixture throughout their full thickness. Tops and curbs shall be non-glaring and black in color. Countertops shall be 1 inch thick and integral curbs shall be 4 inches high and 3/4 inch thick. All exposed edges, except as modified herein, shall be rounded to a 1/4 inch radius. Sink cutouts shall be smooth and uniform without saw marks and the top edge shall have a uniform radius of approximately 1/8 inch. The bottom edge of the sink opening shall be finished smooth with the edge broken to prevent sharpness. Corners of sink cutouts shall be radiused no less than 3/4 inch.

1. Physical Properties:
 - a. Flexural Strength (ASTM Method D790-71): 15,000 psi.
 - b. Compressive Strength (ASTM Method D695-77): 35,000 psi.
 - c. Hardness, Rockwell M (ASTM Method D78-65): 100
 - d. Water Absorption (ASTM Method D570-77):
 - % by weight - 24 Hours: 0.02
 - % by weight - 7 Days: 0.04
 - % by weight - 2 Hour Boil: 0.04
 - e. Specific Gravity: 1.97.
 - f. Tensile Strength: 8,500 psi.
2. Performance Test-Heat Resistance: A high form of porcelain crucible, size 0, 15 ml capacity, shall be heated over a bunsen burner until the crucible bottom attains an incipient red heat. Immediately, the hot crucible shall be transferred to the top surface and allowed to cool to room temperature. Upon removal of the cooled crucible, there shall be no blisters, cracks or any breakdown of the top surface whatsoever.
3. Performance Test-Chemical Resistance: Cover five drops of each reagent with a 25mm watch glass convex side up to duplicate trapping of reagent under a dispensing container. Test all volatiles by using a one once bottle stuffed with saturated cotton. After a 24 hour exposure, flush reagents off with water, clean with naphtha and detergent, rinse and wipe dry.

Test Results:

Reagent		Rating
Hydrochloric Acid	37%	Excellent
Sulfuric Acid	33%	No Effect
Sulfuric Acid	77%	No Effect
Sulfuric Acid	96%	Excellent
Formic Acid	90%	No Effect
Nitric Acid	20%	No Effect
Nitric Acid	30%	No Effect
Nitric Acid	70%	No Effect
Hydrofluoric Acid	48%	Good
Phosphoric Acid	85%	No Effect
Chromic Acid	60%	Good
Acetic Acid	98%	No Effect
3 & 8 Equal Parts		No Effect
Ammonium Hydroxide	28%	No Effect
Sodium Hydroxide	10%	Good
Sodium Hydroxide	20%	Good
Sodium Hydroxide	40%	Good
Sodium Hydroxide Flake		Good
Sodium Sulfide		No Effect
Zinc Chloride		Excellent
Tincture of Iodine		No Effect
Silver Nitrate		No Effect
Methyl Alcohol		No Effect

Butyl Alcohol	No Effect
Benzene	No Effect
Xylene	No Effect
Toluene	No Effect
Gasoline	No Effect
Dichlor Acetic Acid	Excellent
Di Methyl Formamide	Good
Ethyl Acetate	Excellent
Amyl Acetate	No Effect
Acetone	No Effect
Chloroform	Excellent
Carbon Tetrachloride	No Effect
Phenol	Excellent
Cresol	Excellent
Formaldehyde	No Effect
Trichlorethylene	Excellent
Ethyl Ether	No Effect
Furfural	Excellent
Methylene Chloride	No Effect
Mono Chlor Benzene	Excellent
Dioxane	Excellent
Methyl Ethyl Ketone	Good
Acid Dichromate	No Effect
Hydrogen Peroxide	No Effect
Naphthalene	No Effect
Perchloric Acid	70% No Effect

Evaluation Ratings

No Effect:	No detectable change in working surface material.
Excellent:	Slight detectable change in color or gloss, but no change to the function or life of the working surface material.
Good:	A clearly discernable change in color or gloss, but no significant impairment of working surface function or life.

- F. Fasteners: Use name material for rivets, bolts, nuts, studs, spacers and material used for welding as materials joined.
- G. Materials not Defined Specifically: Use same quality normally used by the manufacturer in his standard commercial product, free of defects and imperfections which may affect serviceability and appearance of the finished product.

2.2 FABRICATION

- A. Cabinets: Weld joints in fabricated equipment by acceptable process. Make welds strong and ductile, with exposed surfaces free of imperfections such as pits, runs, spatter or cracks. Welded joints shall be homogeneous with material joined. Use welding rods of same composition as materials welded. Do not substitute spot welding for full welding.
 - 1. Case Construction: Form sides to make rabbeted stile 3/4 to 1-1/8 inch wide, close stile with channel containing shelf adjustment louvers. Reinforce with angles, channels, and gussets to support intended loads. Notch, tightly fit, and weld joints. Construct interior corners coved or square.

Apply sound deadening material on interior hollow metal work. Fabricate top rails and cross rails from U-shaped channels. Enclose backs and bottoms of cabinets. Provide finishing panel on exposed backs of cabinets.

2. Doors: Finish thickness not less than 5/8 inch. Provide internal reinforcement for attachment of hardware. Cushion closing rubber silencers.
 3. Drawers: Flush hollow metal fronts; bodies formed for strength and rigidity, with welded joints; equip with manufacturers standard ball bearing suspension slides within cabinet and drawer side, channels permitting drawers to operate quietly and smoothly and having stops to prevent involuntary removal when extended, but to permit ready removal when extended without the use of tools.
 4. Shelves: Turn edges down 3/4 inch and in 1/2 inch at front and back. Weld reinforcement channels full length of shelves. Shelves and supporting members shall be capable of supporting an evenly distributed load of twenty-five pounds per square foot without visible distortion. Provide 2-inch high clear acrylic plastic raised safety edge, 1/8 inch thick, secured to front edge of shelf. Provide means of positive locking shelf in position, and to permit adjustment without the use of tools.
 5. Hardware: Factory installed. Exposed surfaces chromium plated satin finish with acid and solvent resistant clear coating. Provide positive catch for all drawers with thumb latch release.
 6. Bases: Provide floor mounted cabinets with an integral base recessed three inches to provide toe space.
 7. Finish: After units have been completely welded, submerge in a de-greasing bath and thoroughly rinse to remove dirt, grease and other foreign matter. Before finishing, give surfaces and edges a complete phosphate coating. Finish all surfaces and edges with a baked acid resisting enamel not less than one mil thick. Epoxy powder coat finish is an acceptable alternative.
- B. Countertops: Fabricate in largest sections practicable. Except where otherwise shown, joints shall be flush on top surface, with edges set in epoxy cement. Slightly round exposed edges and corners and finish with enamel to match surface color. Cut drip groove on underside. Securely fasten to supporting rails with heavy metal fastening devices or screws through pierced slots in rails. Use of mastic or adhesives is not permitted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment and materials shall be suitable for installation in available space, arrange for safe and convenient operation.
- B. Furnish supervision of installation at construction site by qualified technician regularly employed by equipment installer.

- C. Fastenings and anchorage for securing metal casework shall be 1/4 inch diameter toggle or expansion bolts, or other appropriate size and type fastening as required. Space fastening devices 12 inches on center with a minimum of three fasteners in each three or four foot unit width. Where type, size of spacing of fastenings is not shown or specified, submit shop drawings for approval showing proposed fastenings and method of installation.
- D. Shields for expansion bolts shall have holding power beyond tensile and shear strength of bolt and breaking strength of nut.
- E. Anchor bolts in concrete shall be drive type with split shanks, closed ends and round or countersunk heads.
- F. Secure cabinets in alignment with sex bolts of other internal fastening devices which are removable from inside the cabinets without special tools. Fastening devices which require the removal of the tops is not permitted.
- G. Anchor floor mounted cabinets with a minimum of four 1/4 inch bolts through 0.104 inch corner gussets. Anchor bolts may be combined with or separate from leveling devices.
- H. install base molding on cabinet bases of floor cabinets after cabinets have been accurately leveled.

3.2 INSPECTION

- A. Before shipment from manufacture's plant, and following installation at the project site, finishes articles shall be thoroughly inspected for compliance with specification.

3.3 TESTS

- A. Perform tests in the presence of the Contracting Officer, of the items specified.
- B. Provide all equipment, instruments and labor required for the tests.
- C. Evidence of malfunction in any test system, piece of equipment of component part thereof that occurs during, or as a result of the test, shall be repaired or replaced, at no additional cost to the government, and the test shall be repeated.

3.4 OPERATING INSTRUCTIONS

- A. Provide three copies of printed instruction booklets and parts lists for specified items. One copy shall be secured to each piece of equipment and two copies shall be delivered to the Project Engineer. These books shall contain:
 - 1. Instructions for installation, operation and maintenance of equipment.
 - 2. List of replaceable parts, quantity of each required, with name and number of each properly identified.

3.5 PROTECTION OF FIXTURES, MATERIAL AND EQUIPMENT

- A. Tightly cover and protect fixtures, material and equipment against dirt, water, and chemicals or mechanical injury. Thoroughly clean

interior and exterior of fixtures, materials and equipment at the
completion of all the work.

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SECTION 12 32 00

WOOD CASEWORK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section covers plastic laminate casework including related components and accessories required to form integral units. Each like item of casework shall be of the same design and by one manufacturer.

1.2 RELATED WORK

- A. Color and Finish of Plastics Laminate: To be selected by Contracting Officer.

1.3 QUALITY CONTROL

- A. Applicator Qualifications: The fabrication and installation of casework shall be by an installer who has successfully produced casework similar to the quality specified and in the quantity shown for a period of not less than two years.
- B. Design Criteria:
 - 1. Casework shall be of the reveal overlay design and, except as otherwise specified, be of premium grade construction and of component thicknesses in conformance with AWI Quality Standards.
 - 2. Exposed surfaces, semi-exposed surfaces, and concealed surfaces of wood casework shall be as defined in AWI Quality Standards.
 - 3. Fastenings for securing casework to adjoining construction shall be as detailed on the drawings. Where type, size or spacing of fastenings is not shown or specified, submit shop drawings for approval showing proposed fastenings and method of installation. See drawings for reinforcement of walls for casework anchorage. Casework shall not be anchored to wood ground strips.

1.4 SUBMITTALS

- A. In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, furnish the following:
- B. Manufacturer's Literature and Data: Adhesive cements
- C. Samples:
 - 1. Plastic laminate, minimum of 24 color samples.
- D. Shop Drawings (1/2 full size):
 - 1. All casework, showing details of construction, including kinds of materials, items of hardware and accessories, and all anchorage details.

2. Fastenings and method of 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. Federal Specifications (Fed. Spec.):
 - L-P-508H.....Plastic Sheet, Laminated, Decorative, And Non-decorative
 - DD-G-451D.....Glass, Float or Plate, Sheet, Figured (Flat, For Glazing, Mirrors And Other Uses)
 - QQ-S-698(3).....Steel, Sheet And Strip, Low-carbon
 - QQ-S-766(5).....Steel Plates, Sheets, And Strip-corrosion Resisting
 - SS-W-40A.....Wall Base: Rubber, And Vinyl Plastic
 - WW-P-541/4A.....Plumbing Fixtures, (Lavatories, Land Use)
 - WW-P-541/5A.....Plumbing Fixtures (Sink, Kitchen And Service And Laundry Tub, Land Use)
- C. U.S. Department of Commerce Commercial Standards (Com. Std.):
 - CS236-66.....Mat-Formed Wood Particleboard
- D. U.S. Department of Commerce Product Standards (Prod. Std.):
 - PS1-74.....Construction And Industrial Plywood
 - PS51-71.....Hardwood and Decorative Plywood
- E. Architectural Woodwork Institute (AWI):
 - Architectural Woodwork Quality Standards, Guide Specifications and Quality Certification Program - 1978

PART 2 - PRODUCTS

2.1 PLASTIC LAMINATE: Fed. Spec. L-P-508:

- A. Style D, Type I, Class 1, not less than 0.040 inches thick for all casework having laminated plastic finish.
- B. Style ND, Type IV not less than 0.030 inches thick for backing sheet.
- C. Prod. Std. PS1, five ply construction from 1/2-inch to 1-1/8 inch thickness, and seven ply for 1-1/4 inch thickness.

2.2 PARTICLEBOARD

Com. Std. CS236, Type I, Density B, Class 2.

2.3 STAINLESS STEEL

Fed. Spec. QQ-S-766, Class 302 or 304, with No. 4 finish.

2.4 HARDWARE

- A. Exposed hardware, except as otherwise specified, shall be satin finished stainless steel, chrome plated steel or zinc-plated steel. The name of the manufacturer, or trademark by which manufacturer can readily be identified, shall be legibly marked.
- B. 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.

2.5 FABRICATION

- A. Fabricate casework of plastic laminated covered particleboard at all exposed surfaces.
- B. Shelves and all semi-concealed surfaces shall be plastic laminated covered particle board.
- C. Base: Provide rubber base in accordance with Specification 09260. Resilient tile flooring.
- D. Countertops: Countertops shall be plastic laminate factory glued to particleboard (CS236) core. Countertops shall be 3/4-inch thick. Cover exposed edges of countertops, and back splashed with plastic laminate.

PART 3 - EXECUTION

3.1 INSTALLATION

Set casework in place; level, plumb, accurately scribe and secure to floor. The installation shall be complete including all trim and hardware. Leave the casework clean and free from defects.

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SECTION 12 34 63

ADAPTABLE LABORATORY FURNITURE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tables.
 - 2. Support structures.
 - 3. Shelves.
 - 4. Suspended base cabinets/wall cases.

1.2 ALTERNATE PROPOSALS

Proposals are invited from alternate manufacturers only if they comply with the minimum design requirements and the minimum performance requirements. A notarized letter stating full compliance must be included in alternate proposals signed by an officer of the manufacturer to ensure compliance.

1.3 SYSTEM DESIGN REQUIREMENTS

- A. Modular dimensioned system of core and panel style support structures and tables.
- B. Cores: Support structure for tables, storage units and shelves, and service chase for all service and drain lines.
 - 1. Modular units shall be suitable for wall, peninsula or island configurations.
 - 2. Cores can be supported with floor plates bolted to floor or with structural tables.
 - 3. Equipped with easy to remove access panels with integral fasteners.
- C. Panels: Support structures for tables, storage units and shelves.
 - 1. Modular units shall be suitable for wall, peninsula or island configurations.
 - 2. Panels can be supported with adjoining perpendicular panels or structural tables or base units.
 - 3. Equipped with easy to remove access panels with integral fasteners.
- D. Tables: Modular, interchangeable work surface support structures in both fixed height and adjustable height configurations.
 - 1. Adjustable height tables include cantilever, four-leg mechanical adjustable, and two-leg crank adjustable configurations.
 - 2. Fixed height tables include two-leg, structural and extended frame configurations.

3. Caster and leveler options are available on both fixed height and adjustable height tables. All other tables are available with levelers only.

E. System requirements:

1. Independently support work surfaces, undercounter cabinets, and overhead storage components.
2. Structural components are essentially self supporting and independent of the building structure.
3. Core type support structures support cupsinks, service fittings, fixtures, and supply and waste lines using commercially available pipe clamps.
4. Cabinet fastening devices cannot be accidentally released from framing system. Intentional release can be easily accomplished without disturbing the cabinet contents by simply loosening two bolts.
5. Core access panels feature integral snap-on "hook and loop" fasteners for quick, easy access to service chase area. All access panels are half width and can be removed even when cabinets are directly in front of the panel.
6. Suspended base cabinets can be removed without removal of the work surface.
7. Wall cabinets are adjustable vertically and laterally and can be removed without the use of tools.
8. Suspended base cabinets can be relocated while fully loaded and installed in any position between table legs.
9. Vertical height of table work surfaces, wall cases and shelves can be adjusted with simple, but positive mechanisms.

1.4 SUBMITTALS

- A. Shop Drawings: Provide 3/4"=1'-0" scale elevations of all components, cross sections, rough-in and anchor placements, tolerances and clearances. Provide 1/4"= 1'-0" rough-in plan drawings for coordination with trades. Rough-in shall show free area.

1.5 QUALITY ASSURANCE

- A. Single source responsibility: Laboratory furniture system, casework, work surfaces, laboratory equipment, chemical fume hoods and accessories shall be manufactured or furnished by a single laboratory furniture company.
- B. Manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled workmen to produced high quality laboratory casework and equipment, and shall meet the following minimum requirements:
 1. Five years or more experience in manufacture of laboratory casework and equipment of type specified.
 2. Ten installations of equal or larger size and requirements.

1.6 REFERENCE STANDARDS

- A. All casework, work surface and service fixture construction and performance characteristics shall be in full compliance with SEFA (Scientific Equipment and Furniture Association) standards. At the owner's request, independent, third party testing must be submitted validating compliance and adheres to the architectural specifications.
 - 1. SEFA 2.3 - Installation of Scientific Laboratory Furniture and Equipment.
 - 2. SEFA 3 - Work Surfaces
 - 3. SEFA 7 - Laboratory and Hospital Fixtures
 - 4. SEFA 8 - Laboratory Furniture

1.7 DELIVERY, STORAGE AND HANDLING

- A. Schedule delivery of laboratory furniture system so that spaces are sufficiently complete that material can be installed immediately following delivery.
- B. Protect finished surfaces from soiling or damage during handling and installation.

1.8 PROJECT CONDITIONS

- A. Do not deliver or install equipment until the following conditions have been met:
 - 1. Windows and doors are installed and the building is secure and weather tight.
 - 2. Ceiling, overhead ductwork and lighting are installed.
 - 3. All painting is completed and floor tile is installed.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Design, materials, construction and finish of casework specified is the minimum acceptable standard of quality for adaptable laboratory casework. The basis of this specification is Fisher Hamilton L.L.C., 1316 - 18th Street, Two Rivers, WI 54241 product.

2.2 TABLES

- A. General requirements for tables:
 - 1. Work surface support frame: 11 gauge cold rolled steel tubing. Cabinet support channels: 14 gauge cold rolled steel. Weld members using the inert gas process.
 - 2. Support arms:
 - a. Cantilever support arms: 11 gauge cold rolled steel.
 - b. 4 leg adjustable height support arms: 11 gauge rolled steel.
 - 3. End caps: Flame resistant ABS plastic, color matched.

4. Finish: Chemical resistant powder paint finish in manufacturer's standard color to be selected.

B. Cantilever Table Frame:

1. Nominal table frame dimensions:
 - a. Width: [24"] [30"] [36"] [48"] [60"] [72"].
 - b. Depth: [23"] [29"].
 - c. Height: [20"].
2. Capable of vertical adjustment in one inch increments.
3. Hanging hook: Five support fingers of 11 gauge cold rolled steel.
4. Leveling/locking stud: Provide in leg member and design to engage the upright and provide a positive means of locking the cantilever table frame to the upright. Stud shall be capable of raising front edge of the work surface 0.120 - 0.150" for leveling purposes.
5. Cantilever table frame shall provide support channels from which suspended cabinets can be hung and adjusted horizontally.
6. Total width of suspended cabinets must be less than the table width to allow for clearance for table frame uprights on 24" deep table frames.
7. Weight capacity: Work surface plus 600 pounds.

C. Structural Table Base:

1. Nominal base dimensions:
 - a. Width: [24"] [30"] [36"] [48"] [60"] [72"].
 - b. Depth: [23"] [29"].
 - c. Height: [26"] [29"] [36"].
2. Capable of attaching to and providing support for cores and panels.
3. Leg members shall have two finger locking hooks.
4. Base unit shall provide support channels from which suspended cabinets can be hung and adjusted horizontally. 29" deep bases shall allow suspended cabinets to be hung directly in front of the leg member for complete cabinet utilization (e.g. 48" suspended cabinet hanging from 48" add-on table base). 29" deep bases shall allow cabinets to straddle leg members, resulting in suspended cabinets hanging from two adjacent table bases. 23" deep bases shall allow cabinet to be hung only between table arm supports.
5. Weight capacity: Work surface plus 600 pounds.

D. Four Leg Adjustable-Height Table

1. Nominal base dimensions:

- a. Width: [36"] [48"] [60"] [72"].
 - b. Depth: [23"] [29"].
 - c. Height range: [28" to 37-3/8"].
 2. Freestanding table capable of supporting suspended base cabinets.
 3. Table can be equipped with levelers or casters.
 4. Outer leg: 11 gauge rolled steel C-channel.
 5. Inner telescoping leg: 16 gauge rolled steel rectangular tubing.
 6. Adjustment mechanism: Mechanical with locking bolts.
 7. Weight capacity: Levelers - 600 pounds; casters - 300 pounds.
- E. Adjustable Height Table (Crank Type):
1. Nominal base dimensions:
 - a. Width: [36"] [48"] [60"].
 - b. Depth: [23"] [29"].
 - c. Height range: [26" to 37"] [29" to 40"].
 2. Base shall be infinitely adjustable and self- locking throughout its 11" range.
 3. Table shall be capable of supporting suspended cabinetry on 24" depth units only.
 4. Front and back shrouds: 20 gauge cold rolled steel.
 5. Structural modesty panel: Box construction of 18 gauge cold rolled steel.
 6. Cross rail: Box construction of 16 gauge rolled steel.
 7. Weight capacity: Work surface plus 300 pounds.
- F. Fixed Height Table:
1. Nominal base dimensions:
 - a. Width: [36"] [48"] [60"] [72"].
 - b. Depth: [23"] [29"] [35"].
 - c. Height: [29"] [36"].
 2. Freestanding table capable of supporting suspended base cabinets.
 3. Rectangular and 90 corner configurations.
 4. Structural modesty panel: Box construction of 18 gauge cold rolled steel.
 5. Leg upright: 16 gauge rolled steel.
 6. Feet: Die cast aluminum.

7. Weight capacity: Work surface plus 600 pounds.

G. Extended Frame Table:

1. Nominal base dimensions:
 - a. Width: [36"] [48"] [60"] [72"].
 - b. Depth: [23"] [29"].
 - c. Height: [29"] [36"] [66"] [84"].
2. Structural modesty panel: Box construction of 18 gauge cold rolled steel with plastic "cable entry" grommets.
3. Base unit shall provide support channels from which suspended cabinets can be hung and adjusted horizontally. 29" deep bases shall allow suspended cabinets to be hung directly in front of the leg member for complete cabinet utilization (e.g. 48" suspended cabinet hanging from 48" table base with structural modesty panel). 29" deep bases shall allow cabinets to straddle leg members, resulting in suspended cabinets hanging from two table bases with structural modesty panels.
4. 16 Gauge Vertical Uprights: Accommodate overhead storage, loaded to accommodate a maximum rating for a total 1520 lbs.
5. Weight capacity: Work surface plus 600 pounds.

2.3 SUPPORT STRUCTURES

A. General requirements for cores and panel type support structures:

1. Riser uprights: 16 gauge rolled steel supplied with leveling guides.
2. Frames: Rolled steel, resistance welded. Frame members and tie rail brackets: 16 gauge; corner gussets: 14 gauge.
3. Tie rails: 16 gauge cold rolled steel.
4. Base cover: 18 gauge cold rolled steel.
5. Slotted adjustment punched into riser upright: notched for one inch adjustment of components supported off riser upright.
6. Riser cap: Flame resistant ABS plastic, color matched.
7. Closure panels: 20 gauge cold rolled steel.
8. Closure panel fasteners: "Dual-lock".
9. Adjustable floor clamps: Two per core or frame; 80-55-06 ductile cast iron.
10. Plug caps: ABS flame retardant plastic, color matched.

B. Island Cores:

1. Nominal dimensions:
 - a. Width: [24"] [30"] [36"] [48"] [60"] [72"].

- b. Depth: [12"].
- c. Height: [36"] [47"] [84"].
- 2. Service area: Minimum 5.50" x 18.25" between uprights and tie rails for service installation.
- 3. Floor clamps: 80-55-06 ductile cast iron, supplied with three rawl bolts for concrete floor anchorage.
- 4. Core shall be capable of having removable uprights and reagent shelf.
- 5. Core shall be capable of having reagent shelf and uprights added after installation.
- 6. Core, when secured to floor, shall be capable of supporting worst-case loading conditions without endriggers.
- 7. Hanging components (cantilever table frames, wall cases, shelves, etc.) shall be vertically adjustable in 1" increments.
- 8. Closure panels shall snap on without tools and shall be removable without removal of cantilever table frames or suspended cabinetry.
- 9. Installed 84" high core shall support following components, each loaded to its maximum rating for a total of 2,820 lbs.
 - a. Inside and outside shelves - 6", 8", 12" - 180 lbs.; 18" - 130 lbs.; 24" - 100 lbs.
 - b. Wall cases - 300 lbs.
 - c. Two cantilever work surfaces - 600 lbs. each side.
- C. Wall Cores:
 - 1. Nominal dimensions:
 - a. Width: [24"] [30"] [36"] [48"] [60"] [72"].
 - b. Depth: 8.75".
 - c. Height: [36"] [47"] [84"].
 - 2. Service area: Minimum 5.50" x 18.25" between uprights and wall and tie rails for service installation.
 - 3. Cross rails: 16 gauge cold rolled steel.
 - 4. Core shall be capable of having removable uprights and reagent shelf.
 - 5. Core shall be capable of having reagent shelf and uprights added after installation.
 - 6. Core, when secured to wall and floor, shall be capable of supporting worst-case loading conditions.
 - 7. Hanging components (cantilever table frames, shelves, etc.) shall be vertically adjustable in one inch increments.

8. Closure panels shall snap on without tools and shall be removable without removal of cantilever table frames or suspended cabinetry.
9. Installed 84" high core shall support following components, each loaded to its maximum rating for a total of 1,680 lbs.
 - a. Inside and outside shelves - 6", 8", 12" - 180 lbs.; 18" - 130 lbs.; 24" - 100 lbs.
 - b. Wall cases - 300 lbs.
 - c. One cantilever work surface - 600 lbs. each side.

D. Island Panels:

1. Nominal dimensions:
 - a. Width: [24"] [30"] [36"] [48"] [60"] [72"].
 - b. Depth: 3.25".
 - c. Height of lower panels: 36".
 - d. Height of upper panels: 48".
 - e. Full height panels: 84".
2. Upper and lower panels shall be of the same materials and construction.
3. Lower panel shall be capable of having upper panel removable.
4. Lower panel shall be capable of having upper panel added after installation.
5. Components (cantilever table frames, shelves, etc.) supported off upper and lower panels shall be vertically adjustable in one inch increments.
6. Closure panels for upper and lower panels shall snap on without tools and shall be removable without removal of cantilever table frames or suspended cabinetry.
7. Installed 84" high island panels shall support following components and loads:
 - a. Outside shelves or wall cases, each loaded to maximum capacity.
 - b. Two cantilever work surfaces, each loaded with 400 lbs; or two structural tables, each loaded with 600 lbs.

E. Wall Panels:

1. Nominal dimensions:
 - a. Width: [24"] [30"] [36"] [48"] [60"] [72"].
 - b. Depth: [3.25"].
 - c. Height: [36"] [84"].

2. Cross rails and cross rail brackets: 16 gauge cold rolled steel, resistance welded.
3. Panels shall be designed so electrical services can be run from one frame to the next.
4. Panels, when secured to wall and floor, shall be capable of supporting worst-case loading conditions without endriggers.
5. Hanging components (cantilever table frames, shelves, etc.) shall be vertically adjustable in one inch increments.
6. Installed 84" high panel shall support following components, each loaded to its maximum rating for a total of 1,140 lbs.
 - a. Three outside shelves or wall cases.
 - b. One cantilever work surface.

F. Universal Column:

1. Nominal dimensions:
 - a. Width: [12"].
 - b. Depth: [12"].
 - c. Height: [36"] [47"] [84"].
2. Corner uprights and column covers: 18 gauge cold rolled steel.
3. Upright connectors: 20 gauge cold rolled steel.
4. Column shall be capable of connecting island cores together when cores are assembled in "L", "T" or cross configuration.
5. Column shall be capable of increasing modularity of island core one foot (e.g. one 3' island core plus a universal column equals modularity of a 4' island).
6. Column shall provide means to bring services down from the ceiling into an island core.
7. Column shall provide closure column to go from 84" up to 120" to house services.
8. Column when used with an island core shall be capable of supporting components within the resulting module (e.g. one 4' cantilever table shall be capable of hanging off a 3' island core/universal column combination).
9. Installed 84" high universal column/island core combination shall support following components, each loaded to its maximum rating for a total of 2,820 lbs.
 - a. Inside and outside shelves.
 - b. Wall cases.
 - c. Two cantilever work surfaces.

G. Corner Column:

1. Nominal dimensions:

- a. Depth/width combination: [12" x 12"] [12" x 8"] [8" x 8"].
 - b. Height: [36"] [47"] [84"].
 2. Corner uprights and column covers: 18 gauge cold rolled steel.
 3. Upright connectors: 20 gauge cold rolled steel.
 4. Column shall be capable of connecting island cores together when cores are assembled in "L", "T" or cross configuration.
 5. Column shall provide means to bring services down from the ceiling into an island core.
 6. Column shall provide closure column to go from 84" up to 120" to house services.
 7. Column shall be capable of connecting island core to wall core.
 8. Column shall be capable of connecting wall core to wall core.
- H. Service Column:
1. Nominal dimensions:
 - a. Width: [18"].
 - b. Depth: [6"].
 - c. Height: [86"].
 2. Uprights: 20 gauge cold rolled steel.
 3. Angles: 18 gauge cold rolled steel.
 4. Column shall be capable of enclosing services which enter through the center of an island core.
 5. Column shall be capable of being constructed around existing services.
 6. Closure panels shall snap on without tools.

2.4 SHELVES

- A. General requirements for shelves:
1. Shelves, hat channel supports, and separate shelf lip: 18 gauge rolled steel.
 2. Shelf brackets: 11 gauge rolled steel.
 3. Vertical shelf adjustment: One inch increments.
 4. Depth and weight capacity: [6" = 180 lbs.] [8" = 180 lbs.] [12" = 180 lbs.] [18" = 130 lbs.] [24" = 100 lbs.]
- B. Outside Shelf:
1. Nominal dimensions:

- a. Length: [24"] [30"] [36"] [48"] [60"] [72"].
- b. Depth: [6"] [8"] [12"] [18"] [24"].
- 2. Shelf shall be capable of being locked into position.
- 3. Shelf brackets shall rise above the shelf surface to provide sides.
- C. Inside Shelf - 12" (Island Core):
 - 1. Nominal dimensions:
 - a. Length: [24"] [30"] [36"] [48"] [60"] [72"].
 - b. Depth: [12"].
 - 2. Shelf key: 11 gauge rolled steel, spring loaded to enhance locking feature.
 - 3. Bracket core: 20 gauge rolled steel.
 - 4. Shelf shall be capable of being locked into position.
- D. Inside Shelf - 8" (Wall Core):
 - 1. Nominal dimensions:
 - a. Length: [24"] [30"] [36"] [48"] [60"] [72"].
 - b. Depth: [8"].

2.5 SUSPENDED BASE CABINETS/WALL CASES

- A. Design requirements, performance requirements, materials, fabrication and hardware shall comply in all respects with fixed wood and/or steel casework specifications in this section.
- B. Suspended cabinet hardware: Provide a system of steel C-channels and brackets attached to the casework frames, enabling the installation and removal of suspended base cabinets without the use of special tools.
- C. Suspended wall case hardware: Provide a system of steel hanger rails attached to the casework frames, to be vertically adjustable on one inch increments. Installation and removal of suspended wall cases to be accomplished without the use of tools.

2.6 FINISHES

- A. Metal finish:
 - 1. Preparation: Spray clean metal with a heated cleaner/phosphate solution, pre-treat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.
 - 2. Application: Electrostatically apply urethane powder coat of selected color and bake in controlled high temperature oven to assure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thickness: **Liquid, dipped, solvent based finishes are not and will not be acceptable.**

- a. Exterior and interior exposed surfaces: 1.5 mil average and 1.2 mil min.
- b. Backs of cabinets and other surfaces not exposed to view: 1.2 mil average.

B. Cabinet Surface Finish Tests:

All casework construction and performance characteristics shall be in full compliance with SEFA 8 standards. At the owner's request, independent, third party performance testing must be submitted validating compliance and adheres to the finish specifications.

1. Chemical Spot Test

1.1 Purpose of Test

The purpose of the chemical spot test is to evaluate the resistance a finish has to chemical spills.

Note: Many organic solvents are suspected carcinogens, toxic and/or flammable. Great care should be exercised to protect personnel and the environment from exposure to harmful levels of these materials.

1.2 Test Procedure

Obtain one sample panel measuring 14" x 24" (355.6mm x 609.6mm). The received sample to be tested for chemical resistance as described herein.

Place panel on a flat surface, clean with soap and water and blot dry. Condition the panel for 48-hours at 73+ 3F (23(+ 2(C) and 50+ 5% relative humidity. Test the panel for chemical resistance using forty-nine different chemical reagents by one of the following methods:

Method A - Test volatile chemicals by placing a cotton ball saturated with reagent in the mouth of a one-ounce (29.574cc) bottle and inverting the bottle on the surface of the panel.

Method B - Test volatile chemicals by placing five drops of the reagent on the surface of the panel and covering with a 24mm watch glass, convex side down.

For both of the above methods, leave the reagents on the panel for a period of **one hour**. Wash off the panel with water, clean with detergent and naphtha, and rinse with deionized water. Dry with a towel and evaluate after 24-hours at 73±3°F (23°±2°C) and 50±5% relative humidity using the following rating system:

Level 0 - No detectable change.

Level 1 - Slight change in color or gloss.

Level 2 - Slight surface etching or severe staining.

Level 3 - Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	A
2.	Acetate, Ethyl	A
3.	Acetic Acid, 98%	B
4.	Acetone	A
5.	Acid Dichromate, 5%	B
6.	Alcohol, Butyl	A
7.	Alcohol, Ethyl	A

8.	Alcohol, Methyl	A
9.	Ammonium Hydroxide, 28%	B
10.	Benzene	A
11.	Carbon Tetrachloride	A
12.	Chloroform	A
13.	Chromic Acid, 60%	B
14.	Cresol	A
15.	Dichlor Acetic Acid	A
16.	Dimethylformamide	A
17.	Dioxane	A
18.	Ethyl Ether	A
19.	Formaldehyde, 37%	A
20.	Formic Acid, 90%	B
21.	Furfural	A
22.	Gasoline	A
23.	Hydrochloric Acid, 37%	B
24.	Hydrochloric Acid, 48%	B
25.	Hydrogen Peroxide, 3%	B
26.	Iodine, Tincture of	B
27.	Methyl Ethyl Ketone	A
28.	Methylene Chloride	A
29.	Mono Chlorobenzene	A
30.	Naphthalene	A
31.	Nitric Acid, 20%	B
32.	Nitric Acid, 30%	B
33.	Nitric Acid, 70%	B
34.	Phenol, 90%	A
35.	Phosphoric Acid, 85%	B
36.	Silver Nitrate, Saturated	B
37.	Sodium Hydroxide, 10%	B
38.	Sodium Hydroxide, 20%	B
39.	Sodium Hydroxide, 40%	B
40.	Sodium Hydroxide, Flake	B
41.	Sodium Hydroxide, Saturated	B
42.	Sulfuric Acid, 33%	B
43.	Sulfuric Acid, 77%	B
44.	Sulfuric Acid, 96%	B
45.	Sulfuric Acid, 77% and Nitric Acid, 70%, equal parts	B
46.	Toluene	A
47.	Trichloroethylene	A
48.	Xylene	A
49.	Zinc Chloride, Saturated	B

1.3 Acceptance Level

Results will vary from manufacturer to manufacturer. **Laboratory grade finishes should result in no more than four Level 3 conditions.** Suitability for a given application is dependent upon the chemicals used in a given laboratory.

2. Hot Water Test

2.1 Purpose of Test

The purpose of this test is to ensure the coating is resistant to hot water.

2.2 Test Procedure

Hot water, 190°F to 205°F (88°C to 96°C), shall be allowed to trickle (with a steady stream and at a rate of not less than 6 ounces (177.44cc) per minute on the surface, which shall be set at an angle of 45-degrees, for a period of five minutes.

2.3 Acceptance Level

After cooling and wiping dry, the finish shall show no visible effect from the hot water.

3. Impact Test

3.1 Purpose of Test

The purpose of this test is to evaluate the ductility of the coating.

3.2 Test Procedure

A one-pound ball approximately 2" (50.8mm) in diameter shall be dropped from a distance of 12" (304.8mm) onto a flat horizontal surface, coated to manufacturer's standard manufacturing method.

3.3 Acceptance Level

There shall be no visible evidence to the naked eye of cracks or checks in the finish due to impact.

4. Paint Adhesion on Steel Test

4.1 Purpose of Test

The paint adhesion test is used to determine the bond of the coating to steel. This does not apply to non-steel products.

4.2 Test Procedure

This test is based on ASTM D2197-86 "Standard Method of Test for Adhesion of Organic Coating". Two sets of eleven parallel lines 1/16" (1.587mm) apart shall be cut with a razor blade to intersect at right angles thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush for one minute. Examine under 100-foot candles of illumination.

4.3 Acceptance Level

Ninety or more of the squares shall show finish intact.

5. Paint Hardness on Steel Test

5.1 Purpose of Test

The paint hardness test is used to determine the resistance of the coatings to scratches.

5.2 Test Procedure

Pencils, regardless of their brand, are valued in this way: 8-H is the hardest, and next 11 order of diminishing hardness are 7-H, 6-H, 5-H, 4-H, 3-H, 2-H, H, F, HB, B (soft), 2-B, 3-B, 4-B, 5-B (which are softest).

The pencils shall be sharpened on emery paper to a wide sharp edge. Pencils of increasing hardness shall be pushed across the paint film in a chisel-like manner until one is found that will cut or scratch the film. The pencil used before that one, that is the hardest pencil that will not rupture the film, is then used to express or designate the hardness.

5.3 Acceptance Level

The paint shall have a hardness of 4-H minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furniture system installation:
 - 1. Install system in strict accordance with manufacturer's instructions.
 - 2. Set system components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as required using concealed shims.
- B. Install suspended casework, work surfaces, sinks and accessory items per Section 12345.

3.2 ADJUSTING

- A. Repair or remove and replace defective work, as directed by [Architect] [Owner] upon completion of installation.

3.3 CLEANING

- A. Clean shop finished laboratory furniture system surfaces and touch up as required.

3.4 PROTECTION OF FINISHED WORK

- A. Provide all necessary protective measures to prevent exposure of laboratory furniture system and attached components from exposure to other construction activity.
- B. Advise contractor of procedures and precautions for protection of material, installed laboratory furniture system, casework and fixtures from damage by work of other trades.

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SECTION 12 34 65

MOBILE CART/WORKSTATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tables
 - 2. Shelves
 - 3. Support Structures
- B. Related Sections:
 - 1. Section 11603 - Laboratory Equipment
 - 2. Section 12344 - Wood Laboratory Casework

1.2 ALTERNATE PROPOSALS

Proposals are invited from alternate manufacturers only if they comply with the minimum design requirements and the minimum performance requirements. A notarized letter stating full compliance must be included in alternate proposals signed by an officer of the manufacturer to ensure compliance.

1.3 SYSTEM DESIGN REQUIREMENTS

- A. Modular dimensioned system of support structures and tables.
- B. Support structure for tables, storage units and shelves.
- C. System requirements:
 - 1. Independently support work surfaces, undercounter cabinets, and overhead storage components.
 - 2. Structural components are essentially self supporting and independent of the building structure.
 - 3. Cabinet fastening devices cannot be accidentally released from framing system. Intentional release can be easily accomplished without disturbing the cabinet contents by loosening two bolts.
 - 4. Base cabinets can be removed without removal of the work surface.
 - 5. Cabinets can be relocated while fully loaded and installed in any position between table legs.
 - 6. Vertical height of table work surfaces, wall cases and shelves can be adjusted with simple, but positive mechanisms.

1.4 SUBMITTALS

- A. Shop Drawings: Provide 3/4" = 1'-0" scale elevations of all components, cross sections, rough-in and anchor placements, tolerances and clearances. Provide 1/4" = 1'0" rough-in plan drawings for coordination with other work. Rough-in shall show free area.

- B. Structural calculations and shop drawings are required to be submitted and approved by the Owner's Representative prior to product being manufactured.
- C. Before commencement of full production manufacturing, submit for Owner's Representative's approval, one complete Type MA moveable cart as shown on sheet A9.71. Do not proceed with full production of the cart before receiving written approval of the sample unit and approval of other submittal items listed above.

1.5 QUALITY ASSURANCE

- A. Single source responsibility: Casework, work surfaces, laboratory metal frames and shelving standards, and all accessories shall be furnished by a single, laboratory casework contractor.
- B. Manufacturers are required to manufacture the product as shown on the drawings and as specified herein, no exceptions.
- C. Manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled workmen to produced high quality laboratory moveable carts and casework, and shall meet the following minimum requirements:
 - 1. Five years or more experience in manufacture of laboratory casework and equipment of type specified.
 - 2. Ten installations of equal or larger size with similar requirements.

1.6 REFERENCE STANDARDS

- A. All casework, worksurface and service fixture construction and performance characteristics shall be in full compliance with SEFA (Scientific Equipment and Furniture Association) standards. At the owner's request, independent, third party testing must be submitted validating compliance and adheres to the architectural specifications.
 - 1. SEFA 2.3 - Installation of Scientific Laboratory Furniture and Equipment.
 - 2. SEFA 3 - Work Surfaces
 - 3. SEFA 7 - Laboratory and Hospital Fixtures
 - 4. SEFA 8 - Laboratory Furniture

1.7 DELIVERY, STORAGE AND HANDLING

- A. Schedule delivery of moveable cart system so that lab spaces are sufficiently complete in order that material can be installed immediately following delivery.
- B. Protect finished surfaces from soiling or damage during handling and installation.

1.8 PROJECT CONDITIONS

- A. Do not deliver or assemble equipment until the following conditions have been met:
 - 1. Windows and doors are installed and the building is secure and weather tight.

2. Ceiling, overhead ductwork and lighting are installed.
3. All painting is completed and floor tile is installed.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Laboratory moveable cart system manufacturer. Fisher Hamilton L.L.C., 1316 - 18th Street, Two Rivers, WI 54241.

2.2 TABLES

- A. General requirements for tables:
 1. Work surface support frame: 11 gauge cold rolled steel tubing. Cabinet support channels: 14 gauge cold rolled steel. Weld members using the inert gas process.
 2. Support arms:
 - a. Cantilever support arms: 11 gauge cold rolled steel.
 3. End caps: Flame resistant ABS plastic, color matched.
- B. Cantilever Table Frame:
 1. Nominal table frame dimensions (each cart is made up of 2 frames):
 - a. Width: 36"
 - b. Depth: 23"
 - c. Height (table frame uprights): 20"
 2. Capable of vertical adjustment in one inch increments.
 3. Hanging hook: Five support fingers of 11 gauge cold rolled steel.
 4. Leveling/locking stud: Provide in leg member and design to engage the upright and provide a positive means of locking the cantilever table frame to the upright. Stud shall be capable of raising front edge of the work surface 0.120 - 0.150 inch for leveling purposes.
 5. Cantilever table frame shall provide support channels from which suspended cabinets can be hung and adjusted horizontally.
 6. 30" deep table frame must allow suspended base cabinets to be positioned in front of table frame uprights.
 7. Weight capacity: Work surface plus 600 pounds.

2.3 SHELVES

- A. General requirements for shelves:
 1. Shelves, hat channel supports, and separate 3" high seismic lip: 18 gauge cold rolled steel.
 2. Shelf brackets: 11 gauge cold rolled steel.
 3. Vertical shelf adjustment: One inch increments.

4. Depth and weight capacity: [6" = 180 lbs.] [8" = 180 lbs.]
[12" = 180 lbs.] [18" = 130 lbs.] [24" = 100 lbs.]
- B. Outside Shelf:
 1. Nominal dimensions:
 - a. Length: 36"
 - b. Depth: 6", 8", 12", 18"
 2. Shelf shall be capable of being locked into position.
- C. Connecting Shelf:
 1. Nominal dimensions:
 - a. Length: 36"
 - b. Depth: 14-1/2"
 2. Locks into existing shelves to form a single depth shelf when carts are locked back-to-back.
 3. Provide 1" high seismic lip at both narrow ends of each shelf.

2.4 SUPPORT STRUCTURES

- A. General requirements for panel type support structures:
 1. Riser uprights: 16 gauge cold rolled steel.
 2. Riser uprights to have an upper and lower portion connected together with an internal connecting device and no external fasteners. Upper riser portion can be removed and lower portion functionality is not to be affected.
 3. Vertical upright: notched for one inch adjustment of components supported off riser upright.
 4. Cart base: 2" x 3" 11 gauge steel rectangular tubing welded together.
 5. Casters: Provide (4) 3" dia. wheels with self-lubricating bearings, rated to carry 365 lb. min. each. Each caster must swivel and have a locking brake.
 6. End caps: ABS plastic, color matched.
 7. Finish: Chemical resistant powder coat paint finish in standard Hamilton colors.
 8. The maximum total load rating of unit is 900 lbs.
 9. The overall height of the mobile cart is 78" to 80", length 49", 61" and 73" and the depth is 30" with upper portion of the uprights attached. If the upper portion of the upright is removed, the overall height is 36.31".
 10. Mobile cart must be able to be tipped 10 degrees in any direction with no accessories attached and be able to right itself to its upright position.
 11. The 6 foot cart must provide for two-three (3) foot long independently adjustable work surfaces and shelving options.

2.5 CASEWORK MATERIALS

- A. Sheet steel: Mild, cold rolled and leveled unfinished steel.
- B. Minimum gauges:
 - 1. 22 gauge: Solid door interior panels, drawer fronts, drawer bodies and shelves.
 - 2. 20 gauge: Case tops, ends, bottoms, bases, backs, vertical posts, uprights, glazed door members, door exterior panels and access panels.
 - 3. 15 gauge: Top front rails, top rear gussets, and intermediate horizontal rails.
 - 4. 14 gauge: Drawer suspensions, door and case hinge reinforcements and front corner reinforcements.

2.6 CHEMICAL RESISTANT PLASTIC LAMINATE WORK SURFACE

- A. Material: Plastic sheet material, GP50, formed of papers treated and coated with thermosetting resins, pressure bonded to one inch thick 45 lb. density particle board core and backed with melamine backer sheet. Bank exposed edges with 3mm edge banding. Provide material in color selected by Owner's Representative from manufacturer's full range of standard colors.

2.7 CASEWORK FABRICATION

- A. Suspended casework: 19" nominal height suspended casework units in one piece, wrap around design with reinforced front and rear posts.
 - 1. Provide finished back on all suspended cabinets.
 - 2. Do not provide toe base on suspended cabinets.
 - 3. Hanging brackets: Provide (2) two piece mechanical clamp brackets at front per cabinet, and (2) rear brackets. When slightly loosened, suspended cabinet can trolley horizontally.
- B. Drawers:
 - 1. Drawer fronts: 3/4" thick, double wall construction, pre-painted prior to assembly and sound deadened.
 - 2. Drawer bodies: Bottom and sides formed into one-piece center section with bottom and sides coved and formed top edges. Front and back panels spot welded to center section.
 - 3. Drawer suspension: Heavy duty covered raceways for both case and drawer with nylon tired, ball bearing rollers; self-centering and self-closing when open to within 5" of the closed position.
 - 4. Provide drawer with rubber bumpers. Friction centering devices are not acceptable.
- C. Shelves:
 - 1. Form front and back edges down and back 3/4". Form ends down 3/4".

2. Reinforce shelves over 36" long with welded hat channel reinforcement the full width of shelf.

D. Hardware:

1. Drawer recessed pulls: Manufacturer's standard plastic pulls.

2.8 METAL FINISH

A. Metal finish:

1. Preparation: Spray clean metal with a heated cleaner/phosphate solution, pre-treat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.
2. Application: Electrostatically apply urethane powder coat of selected color and bake in controlled high temperature oven to assure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thickness: **Liquid, dipped, solvent based finishes are not and will not be acceptable.**
 - a. Exterior and interior exposed surfaces: 1.5 mil average and 1.2 mil min.
 - b. Backs of cabinets and other surfaces not exposed to view: 1.2 mil average.

B. Cabinet Surface Finish Tests:

All casework construction and performance characteristics shall be in full compliance with SEFA 8 standards. At the owner's request, independent, third party performance testing must be submitted validating compliance and adheres to the finish specifications.

1. Chemical Spot Test

1.1 Purpose of Test

The purpose of the chemical spot test is to evaluate the resistance a finish has to chemical spills.

Note: Many organic solvents are suspected carcinogens, toxic and/or flammable. Great care should be exercised to protect personnel and the environment from exposure to harmful levels of these materials.

1.2 Test Procedure

Obtain one sample panel measuring 14" x 24" (355.6mm x 609.6mm). The received sample to be tested for chemical resistance as described herein.

Place panel on a flat surface, clean with soap and water and blot dry. Condition the panel for 48-hours at 73+ 3F (23(+ 2(C) and 50+ 5% relative humidity. Test the panel for chemical resistance using forty-nine different chemical reagents by one of the following methods:

Method A - Test volatile chemicals by placing a cotton ball saturated with reagent in the mouth of a one-ounce (29.574cc) bottle and inverting the bottle on the surface of the panel.

Method B - Test volatile chemicals by placing five drops of the reagent on the surface of the panel and covering with a 24mm watch glass, convex side down.

For both of the above methods, leave the reagents on the panel for a period of **one hour**. Wash off the panel with water, clean with detergent and naphtha, and rinse with deionized water. Dry with a towel and evaluate after 24-hours at 73±3°F (23°±2°C) and 50±5% relative humidity using the following rating system:

Level 0 - No detectable change.

Level 1 - Slight change in color or gloss.

Level 2 - Slight surface etching or severe staining.

Level 3 - Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	A
2.	Acetate, Ethyl	A
3.	Acetic Acid, 98%	B
4.	Acetone	A
5.	Acid Dichromate, 5%	B
6.	Alcohol, Butyl	A
7.	Alcohol, Ethyl	A
8.	Alcohol, Methyl	A
9.	Ammonium Hydroxide, 28%	B
10.	Benzene	A
11.	Carbon Tetrachloride	A
12.	Chloroform	A
13.	Chromic Acid, 60%	B
14.	Cresol	A
15.	Dichlor Acetic Acid	A
16.	Dimethylformamide	A
17.	Dioxane	A
18.	Ethyl Ether	A
19.	Formaldehyde, 37%	A
20.	Formic Acid, 90%	B
21.	Furfural	A
22.	Gasoline	A
23.	Hydrochloric Acid, 37%	B
24.	Hydrochloric Acid, 48%	B
25.	Hydrogen Peroxide, 3%	B
26.	Iodine, Tincture of	B
27.	Methyl Ethyl Ketone	A
28.	Methylene Chloride	A
29.	Mono Chlorobenzene	A
30.	Naphthalene	A
31.	Nitric Acid, 20%	B
32.	Nitric Acid, 30%	B
33.	Nitric Acid, 70%	B
34.	Phenol, 90%	A
35.	Phosphoric Acid, 85%	B
36.	Silver Nitrate, Saturated	B
37.	Sodium Hydroxide, 10%	B
38.	Sodium Hydroxide, 20%	B
39.	Sodium Hydroxide, 40%	B
40.	Sodium Hydroxide, Flake	B

41.	Sodium Hydroxide, Saturated	B
42.	Sulfuric Acid, 33%	B
43.	Sulfuric Acid, 77%	B
44.	Sulfuric Acid, 96%	B
45.	Sulfuric Acid, 77% and Nitric Acid, 70%, equal parts	B
46.	Toluene	A
47.	Trichloroethylene	A
48.	Xylene	A
49.	Zinc Chloride, Saturated	B

1.3 Acceptance Level

Results will vary from manufacturer to manufacturer.
Laboratory grade finishes should result in no more than four Level 3 conditions. Suitability for a given application is dependent upon the chemicals used in a given laboratory.

2. Hot Water Test

2.1 Purpose of Test

The purpose of this test is to ensure the coating is resistant to hot water.

2.2 Test Procedure

Hot water, 190°F to 205°F (88°C to 96°C), shall be allowed to trickle (with a steady stream and at a rate of not less than 6 ounces (177.44cc) per minute on the surface, which shall be set at an angle of 45-degrees, for a period of five minutes.

2.3 Acceptance Level

After cooling and wiping dry, the finish shall show no visible effect from the hot water.

3. Impact Test

3.1 Purpose of Test

The purpose of this test is to evaluate the ductility of the coating.

3.2 Test Procedure

A one-pound ball approximately 2" (50.8mm) in diameter shall be dropped from a distance of 12" (304.8mm) onto a flat horizontal surface, coated to manufacturer's standard manufacturing method.

3.3 Acceptance Level

There shall be no visible evidence to the naked eye of cracks or checks in the finish due to impact.

4. Paint Adhesion on Steel Test

4.1 Purpose of Test

The paint adhesion test is used to determine the bond of the coating to steel. This does not apply to non-steel products.

4.2 Test Procedure

This test is based on ASTM D2197-86 "Standard Method of Test for Adhesion of Organic Coating". Two sets of eleven parallel lines 1/16" (1.587mm) apart shall be cut with a razor blade to intersect at right angles thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush for one minute. Examine under 100-foot candles of illumination.

4.3 Acceptance Level

Ninety or more of the squares shall show finish intact.

5. Paint Hardness on Steel Test

5.1 Purpose of Test

The paint hardness test is used to determine the resistance of the coatings to scratches.

5.2 Test Procedure

Pencils, regardless of their brand, are valued in this way: 8-H is the hardest, and next 11 order of diminishing hardness are 7-H, 6-H, 5-H, 4-H, 3-H, 2-H, H, F, HB, B (soft), 2-B, 3-B, 4-B, 5-B (which are softest).

The pencils shall be sharpened on emery paper to a wide sharp edge. Pencils of increasing hardness shall be pushed across the paint film in a chisel-like manner until one is found that will cut or scratch the film. The pencil used before that one, that is the hardest pencil that will not rupture the film, is then used to express or designate the hardness.

5.3 Acceptance Level

The paint shall have a hardness of 4-H minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cart system installation:

1. Assemble system in strict accordance with manufacturer's instructions.

3.2 ADJUSTING

- ##### **A. Repair or remove and replace defective work, as directed by (Owner's representative) upon completion of installation.**

3.3 CLEANING

- A. Clean shop finished laboratory furniture system surfaces and touch up as required.

3.4 PROTECTION OF FINISHED WORK

- A. Do not install until construction is complete on the project.
- B. Advise Owner's Representative of procedures and precautions for protection of material, installed laboratory furniture system, casework and fixtures from damage by other work.

- - - E N D - - -

SECTION 12 34 66

WALL RAIL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Worktops
 2. Support Structures
 3. Shelves
 4. Upper and Lower Storage Units

1.2 ALTERNATE PROPOSALS

Proposals are invited from alternate manufacturers only if they comply with the minimum design requirements and the minimum performance requirements. A notarized letter stating full compliance must be included in alternate proposals signed by an officer of the manufacturer to ensure compliance.

1.3 MINIMUM DESIGN REQUIREMENTS

- A. System components, cabinets, tops and accessories must be interchangeable within the system to allow for maximum adjustability.
- B. Modular dimensioned system of 1-1/4" (width) x 1" (depth) wall rail style support structures.
- C. Wall Rail: Wall attached support structure for tables, storage units and shelves, and component accessories.
1. Modular units shall be suitable for wall, peninsula or island configurations.
 2. Slotted Vertical Rails can be supported by horizontal channels bolted to wall structure.
 3. Equipped with easy to remove insert panels.
- D. Minimum System Requirements
1. Independently cantilevered support work surfaces, undercounter cabinets, and overhead storage components.
 2. Cabinet fastening devices cannot be accidentally released from framing system. Intentional release can be easily accomplished without disturbing the cabinet contents by simply loosening four bolts.
 3. Base cabinets can be removed without removal of the work surface.
 4. Wall cabinets are adjustable vertically and laterally and can be removed with the use of simple hand tools.
 5. Cabinets can be relocated while fully loaded and installed in any position between cantilevered table support arms on 23" deep work surfaces.
 6. Vertical height of table work surfaces, wall cases and

shelves can be adjusted with simple, but positive mechanisms (on one inch increments).

7. Work surface must support a minimum of 400 lb., live loads, shelves must support a minimum of 180 lbs. - 6" deep shelves to 100 lbs. - 24" deep shelves live loads.
8. Cabinets can be mounted in front of cantilevered support arms on 29" deep worksurfaces.

1.4 SUBMITTALS

- A. Shop Drawings: Provide 1/2" = 1'-0" scale elevations of all components, cross sections, rough-in and anchor placements, tolerances and clearances. Provide 1/4" = 1'-0" rough-in plan drawings for coordination with trades. Rough-in shall show free area.
- B. Provide color selection charts from manufacturer's standard colors.
- C. Instruction: Submit for review and approval written instructions in booklet form providing additional details on safe and proper operation and maintenance.

1.5 QUALITY ASSURANCE

- A. Single source responsibility: Laboratory furniture system and work surfaces shall be manufactured or furnished by a single laboratory furniture company.
- B. Manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled workmen to produce high quality casework and equipment, and shall meet the following minimum requirements.
 1. Five years or more experience in manufacture of laboratory casework.
 2. Ten or more installations of equal or larger size and requirements.

1.6 REFERENCE STANDARDS

- A. All casework, worksurface and service fixture construction and performance characteristics shall be in full compliance with SEFA (Scientific Equipment and Furniture Association) standards. At the owner's request, independent, third party testing must be submitted validating compliance and adheres to the architectural specifications.
 1. SEFA 2.3 - Installation of Scientific Laboratory Furniture and Equipment.
 2. SEFA 3 - Work Surfaces
 3. SEFA 7 - Laboratory and Hospital Fixtures
 4. SEFA 8 - Laboratory Furniture

1.7 DELIVERY, STORAGE AND HANDLING

- A. Schedule delivery of laboratory furniture system so that spaces are sufficiently complete that material can be installed immediately following delivery.

- B. Protect finished surfaces from soiling or damage during handling and installation.

1.8 PROJECT CONDITIONS

- A. Do not deliver or install equipment until the following conditions have been met:
 - 1. Windows and doors are installed and the building is secure and weathertight.
 - 2. Ceiling, overhead ductwork and lighting are installed.
 - 3. All painting is completed and floor tile is installed.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Laboratory Furniture System Manufacturer:

Fisher Hamilton L.L.C.
1316 - 18th Street
Two Rivers, WI 54241
(414) 793-1121

2.2 WORK SURFACES AND SUPPORTS

- A. Cantilever Table Frame:
 - 1. Nominal table frame dimensions:
 - a. Width: 24", 30", 36", 48", 60" and 72"
 - b. Depth: 23", 29"
 - c. Height: 20"
 - 2. Capable of vertical adjustment in one inch increments.
 - 3. Hanging hook: Five support fingers of 11 gauge cold rolled steel.
 - 4. Leveling/locking stud: Provide in leg member and design to engage the upright and provide a positive means of locking the cantilever table frame to the upright. Stud shall be capable of raising front edge of the work surface 0.120 - 0.150 inch for leveling purposes.
 - 5. Cantilever table frame shall provide support channels from which suspended cabinets can be hung and adjusted horizontally.
 - 6. Total width of suspended cabinets must be equal to the table width on 29" deep table frames.
 - 7. Weight capacity: 600 pounds includes the work surface.

2.3 SUPPORT STRUCTURES

- A. General requirements for wall rail type support structures:
 - 1. Horizontal Vertical Rails: Cold rolled 11 gauge steel, slotted vertical, notched for one inch adjustment of

components.

2. Horizontal Frames: Cold rolled steel, 11 gauge slotted for 6 inch adjustment of vertical rails.
3. Base cover: 18 gauge cold rolled steel.
4. Insert panels: 20 gauge cold rolled steel/or optional fabric covered tackboard.

B. Wall Rails:

1. Nominal dimensions:
 - a. Width: single slotted 1-1/2", double slotted 3"
 - b. Depth: 1.0"
 - c. Height: 36", 84"
2. Horizontal cross rails: 14 gauge cold rolled steel.
3. Rail, when secured to wall, shall be capable of supporting worst-case loading conditions.
4. Hanging components (cantilever table frames, shelves, etc.) shall be vertically adjustable in one inch increments.
5. Closure panels shall be inserted without tools and shall be removable without removal of cantilever table frames or suspended cabinetry.
6. Installed 84" high rails shall support following components, each loaded to its maximum rating:
 - a. Outside shelves.
 - b. Wall cases.
 - c. One cantilever work surface.

2.4 SHELVES

A. General requirements for shelves:

1. Shelves, have removable shelf lip: 18 gauge cold rolled steel.
2. Shelf brackets: 11 gauge cold rolled steel.
3. Vertical shelf adjustment: One inch increments.
4. Depth and weight capacity: 6" = 180 lbs.; 12" = 180 lbs.; 18" = 130 lbs.; 24" = 100 lbs.
5. Shelf shall be capable of being locked into position.

2.5 FINISHES

A. Metal finish:

1. Preparation: Spray clean metal with a heated cleaner/phosphate solution, pre-treat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.
2. Application: Electrostatically apply urethane powder coat of selected color and bake in controlled high temperature

oven to assure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thickness: Liquid, dipped, solvent based finishes are not and will not be acceptable.

- a. Exterior and interior exposed surfaces: 1.5 mil average and 1.2 mil min.
 - b. Backs of cabinets and other surfaces not exposed to view: 1.2 mil average.
- B. Cabinet Surface Finish Tests: All casework construction and performance characteristics shall be in full compliance with SEFA 8 - 1999 standards. At the owner's request, independent, third party performance testing must be submitted validating compliance and adheres to the finish specifications.
1. Chemical Spot Test
 - a. Purpose of Test:
 - (1) The purpose of the chemical spot test is to evaluate the resistance a finish has to chemical spills.

Note: Many organic solvents are suspected carcinogens, toxic and/or flammable. Great care should be exercised to protect personnel and the environment from exposure to harmful levels of these materials.
 - b. Test Procedure
 - (1) Obtain one sample panel measuring 14" x 24" (355.6mm x 609.6mm). The received sample to be tested for chemical resistance as described herein.
 - (2) Place panel on a flat surface, clean with soap and water and blot dry. Condition the panel for 48-hours at 73+ 3F (23(+ 2(C) and 50+ 5% relative humidity. Test the panel for chemical resistance using forty-nine different chemical reagents by one of the following methods:
 - (3) Method A - Test volatile chemicals by placing a cotton ball saturated with reagent in the mouth of a one-ounce (29.574cc) bottle and inverting the bottle on the surface of the panel.
 - (4) Method B - Test volatile chemicals by placing five drops of the reagent on the surface of the panel and covering with a 24mm watch glass, convex side down.
 - (5) For both of the above methods, leave the reagents on the panel for a period of one hour. Wash off the panel with water, clean with detergent and naphtha, and rinse with deionized water. Dry with a towel and evaluate after 24-hours at 73±3°F (23°±2°C) and 50±5% relative humidity using the following rating system:

Level 0 - No detectable change.

Level 1 - Slight change in color or gloss.

Level 2 - Slight surface etching or severe staining.

Level 3 - Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	A
2.	Acetate, Ethyl	A
3.	Acetic Acid, 98%	B
4.	Acetone	A
5.	Acid Dichromate, 5%	B
6.	Alcohol, Butyl	A
7.	Alcohol, Ethyl	A
8.	Alcohol, Methyl	A
9.	Ammonium Hydroxide, 28%	B
10.	Benzene	A
11.	Carbon Tetrachloride	A
12.	Chloroform	A
13.	Chromic Acid, 60%	B
14.	Cresol	A
15.	Dichlor Acetic Acid	A
16.	Dimethylformamide	A
17.	Dioxane	A
18.	Ethyl Ether	A
19.	Formaldehyde, 37%	A
20.	Formic Acid, 90%	B
21.	Furfural	A
22.	Gasoline	A
23.	Hydrochloric Acid, 37%	B
24.	Hydrochloric Acid, 48%	B
25.	Hydrogen Peroxide, 3%	B
26.	Iodine, Tincture of	B
27.	Methyl Ethyl Ketone	A
28.	Methylene Chloride	A
29.	Mono Chlorobenzene	A
30.	Naphthalene	A
31.	Nitric Acid, 20%	B
32.	Nitric Acid, 30%	B
33.	Nitric Acid, 70%	B
34.	Phenol, 90%	A
35.	Phosphoric Acid, 85%	B
36.	Silver Nitrate, Saturated	B
37.	Sodium Hydroxide, 10%	B
38.	Sodium Hydroxide, 20%	B
39.	Sodium Hydroxide, 40%	B
40.	Sodium Hydroxide, Flake	B
41.	Sodium Hydroxide, Saturated	B
42.	Sulfuric Acid, 33%	B
43.	Sulfuric Acid, 77%	B
44.	Sulfuric Acid, 96%	B
45.	Sulfuric Acid, 77% and Nitric Acid, 70%, equal parts	B
46.	Toluene	A
47.	Trichloroethylene	A
48.	Xylene	A
49.	Zinc Chloride, Saturated	B

c. Acceptance Level:

- (1) Results will vary from manufacturer to manufacturer. Laboratory grade finishes should

result in no more than four Level 3 conditions.
Suitability for a given application is dependent
upon the chemicals used in a given laboratory.

2. Hot Water Test

- a. Purpose of Test: The purpose of this test is to ensure the coating is resistant to hot water.
- b. Test Procedure: Hot water, 190°F to 205°F (88°C to 96°C), shall be allowed to trickle (with a steady stream and at a rate of not less than 6 ounces (177.44cc) per minute on the surface, which shall be set at an angle of 45-degrees, for a period of five minutes.
- b. Acceptance Level: After cooling and wiping dry, the finish shall show no visible effect from the hot water.

3. Impact Test

- a. Purpose of Test: The purpose of this test is to evaluate the ductility of the coating.
- c. Test Procedure: A one-pound ball approximately 2" (50.8mm) in diameter shall be dropped from a distance of 12" (304.8mm) onto a flat horizontal surface, coated to manufacturer's standard manufacturing method.
- d. Acceptance Level: There shall be no visible evidence to the naked eye of cracks or checks in the finish due to impact.

4. Paint Adhesion on Steel Test

- a. Purpose of Test: The paint adhesion test is used to determine the bond of the coating to steel. This does not apply to non-steel products.
- b. Test Procedure: This test is based on ASTM D2197-86 "Standard Method of Test for Adhesion of Organic Coating". Two sets of eleven parallel lines 1/16" (1.587mm) apart shall be cut with a razor blade to intersect at right angles thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush for one minute. Examine under 100-foot candles of illumination.
- c. Acceptance Level: Ninety or more of the squares shall show finish intact.

5. Paint Hardness on Steel Test

- a. Purpose of Test: The paint hardness test is used to determine the resistance of the coatings to scratches.
- b. Test Procedure:
 - (1) Pencils, regardless of their brand, are valued in this way: 8-H is the hardest, and next 11 order of diminishing hardness are 7-H, 6-H, 5-H,

4-H, 3-H, 2-H, H, F, HB, B (soft), 2-B, 3-B, 4-B, 5-B (which are softest).

- (2) The pencils shall be sharpened on emery paper to a wide sharp edge. Pencils of increasing hardness shall be pushed across the paint film in a chisel-like manner until one is found that will cut or scratch the film. The pencil used before that one, that is the hardest pencil that will not rupture the film, is then used to express or designate the hardness.

- c. Acceptance Level: The paint shall have a hardness of 4-H minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furniture system installation:
1. Install system in strict accordance with manufacturer's instructions.
 2. Set system components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as required using concealed shims.

3.2 ADJUSTING

- A. Repair or remove and replace defective work, as directed by FAU (Facilities Planning Representative) upon completion of installation.

3.3 CLEANING

- A. Clean shop finished laboratory furniture system surfaces and touch up as required.
- B. Clean all dust, dirt and debris resulting from installation from floors and walls.

3.4 PROTECTION OF FINISHED WORK

- A. Provide all necessary protective measures to prevent exposure of laboratory furniture system and attached components from exposure to other construction activity.
- B. Advise contractor of procedures and precautions for protection of material, installed laboratory furniture system, casework and fixtures from damage by work of other trades.

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SECTION 12 36 00

COUNTERTOPS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies casework countertops with integral accessories.
- B. Integral accessories include:
 - 1. Sinks with traps and drains.
 - 2. Eye and Face Wash Units.
 - 3. Mechanical Service fixtures.
 - 4. Electrical Receptacles.
 - 5. Hot Plates (Range)
 - 6. Pegboards

1.2 RELATED WORK

- A. Color and patterns of plastic laminate: SECTION 09 06 00, SCHEDULE FOR FINISHES.
- B. DIVISION 22, PLUMBING.
- C. DIVISION 26, ELECTRICAL.
- D. Equipment Reference Manual for SECTION 12 36 00, COUNTERTOPS.

1.3 SUBMITTALS

- A. Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings
 - 1. Show dimensions of section and method of assembly.
 - 2. Show details of construction at 1/2 scale.
- C. Samples:
 - 1. 150 mm (6 inch) square samples each top.
 - 2. Front edge, back splash, end splash and core with surface material and booking.

1.4 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 Hardboard Association (AHA):
 - A135.4-95..... Basic Hardboard
- C. Composite Panel Association (CPA):
 - A208.1-09..... Particleboard
- D. American Society of Mechanical Engineers (ASME):
 - A112.18.1-05..... Plumbing Supply Fittings
 - A112.1.2-04..... Air Gaps in Plumbing System
 - A112.19.3-08(R2004). Stainless Steel Plumbing Fixtures (Designed for Residential Use)
- E. American Society for Testing and Materials (ASTM):
 - A167-99 (R2009)..... Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
 - A1008-09..... Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength, Low Alloy
 - D256-06..... Pendulum Impact Resistance of Plastic
 - D570-98(R2005)..... Water Absorption of Plastics
 - D638-08..... Tensile Properties of Plastics
 - D785-08..... Rockwell Hardness of Plastics and Electrical Insulating Materials
 - D790-07..... Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - D4690-99(2005)..... Urea-Formaldehyde Resin Adhesives
 - G21-96 (R2002)..... Determining Resistance of Synthetic Polymeric Materials to Fungi
- F. Federal Specifications (FS):
 - A-A-1936..... Adhesive, Contact, Neoprene Rubber
- G. U.S. Department of Commerce, Product Standards (PS):
 - PS 1-95..... Construction and Industrial Plywood
- H. National Electrical Manufacturers Association (NEMA):
 - LD 3-05..... High Pressure Decorative Laminates
 - LD 3.1-95..... Performance, Application, Fabrication, and Installation of High Pressure Decorative Laminates

2.1 MATERIALS

A. Plastic Laminate: NEMA LD 3.

1. Concealed backing sheet Type BKL.
2. Decorative surfaces:
 - a. Flat components: Type GP-HGL.
 - b. Post forming: Type PF-HGP.
3. Chemical Resistant Surfaces
 - a. Flat components: Type GP-HGL.
 - b. Post forming: Type PF-HGP.
 - c. Resistance to reagents:
 - 1) Test with five 0.25 mil drops remaining on surface for 16 hours followed by washing off with tap water, then cleaned with liquid soap and water, dried with soft cotton cloth and then cleaned with naphtha.
 - 2) No change in color, surface texture, and original protectability remaining from test results of following reagents:

98% Acetic Acid	Butyl Alcohol	Acetone
90% Formic Acid--	Benzine	Chloroform
28% Ammonium Hydroxide	Xylene	Carbon Tetrachloride
Zinc Chloride (Sat.)	Toluene	Cresol
Sodium Carbonate (Sat.)	Gasoline	Ether
Calcium Hypochlorite (Sat.)	Kerosene	Cottonseed Oil
Sodium Chloride (Sat.)	Mineral Oil	40% Formaldehyde
Methyl Alcohol	Ethyl Acetate	Trichlorethylene
Ethyl Alcohol	Amyl Acetate	Monochlorobenzine

- 3) Superficial effects only: Slight color change, spot, or residue only with original protectability remaining from test results of following reagents:

77% Sulfuric Acid	37% Hydrochloric Acid	85% Phenol
33% Sulfuric Acid	20% Nitric Acid	Furfural
85% Phosphoric Acid	30% Nitric Acid	Dioxane

- 4) Minimum height of impact resistance: 300 mm (12 inches).

B. Molded Resin:

1. Non-glare epoxy resin or furan resin compounded and cured for minimum physical properties specified:

Flexural strength	70 MPa (10,000 psi)	ASTM D790
Rockwell hardness	105	ASTM D785
Water absorption, 14 hours (weight)	.01%	ASTM D570

2. Material of uniform mixture throughout.

C. Stainless Steel: ASTM A167, Type 304.

D. Sheet Steel: ASTM A1008, cold rolled, Class 1 finish, stretcher leveled.

E. Particleboard: CPA A208.1, Grade 2-M-2.

F. Plywood: PS 1, Exterior type, veneer grade AC not less than five ply construction.

G. Hardwood Countertop: Solid maple, clear grade except where otherwise specified.

H. Hardboard: ANSI/AHA A135.4, Type I, tempered, fire retardant treated, smooth surface one side.

I. Adhesive

1. For plastic laminate FS A-A-1936.
2. For wood products: ASTM D4690, unextended urea resin or unextended melamine resin, phenol resin, or resorcinol resin.
3. For Field Joints:
 - a. Epoxy type, resistant to chemicals as specified for plastic laminate laboratory surfaces.
 - b. Fungiresistant: ASTM G-21, rating of 0.

J. Fasteners:

1. Metals used for welding same metal as materials joined.
2. Use studs, bolts, spaces, threaded rods with nuts or screws suitable for materials being joined with metal splice plates, channels or other supporting shape.

K. Solid Polymer Material:

1. Filled Methyl Methacrylic Polymer.

2. Performance properties required:

Property	Result	Test
Elongation	0.3% min.	ASTM D638
Hardness	90 Rockwell M	ASTM D785
Gloss (60° Gordon)	5-20	NEMA LD3.1
Color stability	No change	NEMA LD3 except 200 hour
Abrasion resistance	No loss of pattern Max wear depth 0.0762 mm (0.003 in) - 10000 cycles	NEMA LD3
Water absorption weight (5 max)	24 hours 0.9	ASTM D-570
Izod impact	14 N·m/m (0.25 ft-lb/in)	ASTM D256 (Method A)
Impact resistance	No fracture	NEMA LD-3 900 mm (36") drop 1 kg (2 lb.) ball
Boiling water surface resistance	No visible change	NEMA LD3
High temperature resistance	Slight surface dulling	NEMA LD3

3. Cast into sheet form and bowl form.
4. Color throughout with subtle veining through thickness.
5. Joint adhesive and sealer: Manufacturers silicone adhesive and sealant for joining methyl methacrylic polymer sheet.
6. Bio-based products will be preferred.

L. Laminar Flow Control Device

1. 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.
2. Flow Control Restrictor:
 - a. Capable of restricting flow of 7.5 to 8.5 Lpm (2.0 to 2.2 gpm) for sinks provided in paragraph 2.2D.
 - b. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 175 and 550 kPa (25 and 80 psi).
 - c. Operates by expansion and contraction, eliminates mineral/sediment building up with self clearing action, and is capable of easy manual cleaning.

2.2 SINKS

A. Molded Resin:

1. Cast or molded in one piece with interior corners 25 mm (one inch) minimum radius.

2. Minimum thickness of sides and ends 13 mm (1/2 inch), bottom 16 mm (5/8 inch).
 3. Molded resin outlet for drain and standpipe overflow.
 4. Provide clamping collar permitting connection to 38 mm (1-1/2 inch) or 50 mm (2 inch) waste outlet and trap, making sealed but not permanent connection.
- B. Stainless Steel:
1. ANSI/ASME A112.19.3, Type 304.
 2. Self rim for plastic laminate or similar tops with concealed fasteners.
 3. Flat rim for welded into stainless steel tops.
 4. Ledge back or ledge sides with holes to receive required fixtures when mounted on countertop.
 5. Apply fire resistant sound deadening material to underside.
- C. Stainless steel circular or oval shaped bowl.
- D. Sinks of Methyl Methacrylic Polymer:
1. Minimum 19 mm (3/4 inch) thick, cast into bowl shape with overflow to drain.
 2. Provide for underhung installation to countertop.
 3. Provide openings for drain.

2.3 TRAPS AND FITTINGS

- A. Material as specified in DIVISION 22, PLUMBING.
- B. For Molded Resin Sinks:
1. Chemical resisting P-traps and fittings for chemical waste service.
 2. Provide traps with cleanout plug easily removable without tools.
- C. For Stainless Steel Sinks:
1. Either cast or wrought brass or stainless steel P-traps and drain fittings; ASME A112.18.1
 2. Flat strainer, except where cup strainer or overflow standpipe specified.
 - a. Provide cup strainer in cabinet type 1B.
 - b. Provide stainless steel overflow stand pipe to within 38 mm (1-1/2 inches) of sink rim.
 3. Exposed surface chromium plated finish.

D. Plaster traps:

1. Cast iron body with porcelain enamel exterior finish.
2. 50 mm (2 inch) female threaded side inlet and outlet.
3. Removable galvanized cage having integral baffles and replaceable brass screens.
4. Removable gasketed cover.
5. Minimum overall dimensions: 350 x 350 x 400 mm high (14 x 14 x 16 inches) with 175 mm (7 inch) water seal.
6. Non-siphoning and easily accessible for cleaning.

E. Air Gap Fittings: ASME A112.1.2.

F. Methyl Methacrylic Polymer Sink Traps:

1. Cast or wrought brass with flat grid strainer, off-set tail piece, adjustable 38 x 32 mm (1-1/2 x 1 1/4-inch) P trap.
2. Chromium plated finish.

2.4 WATER FAUCETS

A. ASME A112.18.1.

1. Cast or forged brass, compression type with replaceable seat and stem assembly or replaceable cartridge.
2. Indexed, forearm lever handles either with or without head as selected by the Architect.
3. Gooseneck minimum clearance above countertop of 190 mm (7-1/2 inches), bent 180 degrees for vertical discharge.
4. Swing spouts elevated to clear handles.
5. Exposed brass surfaces chromium plated.
6. Cast combination hot and cold fixture with one piece body for multiple outlets.
7. Adapter type connection which will permit field conversion of swing spouts to fixed or gooseneck grouts or vice versa.
8. Pedestals Top for Laboratory or Pharmacy:
 - a. Modern design tapered to a round base, factory assembled and tested.
 - b. Brass shanks, locknuts and washers for attaching to top or curbs.

B. Laminar flow control device on spouts.

C. Automatic Controlled Faucets.

1. Infra-red photocell sensor and a solenoid valve to control water flow automatically.
 2. Breaking light beam activates water flow.
 3. Water stops when user moves away from light beam.
- C. Laboratory and Pharmacy Faucets:
1. Female 9 mm (3/8 inch) IPS threaded outlet for attachment of filter pumps, hose connectors, anti-hose nozzle, or laminar flow control device on spout end.
 2. Provide angle type vacuum breaker for fixture, designed for low flow, with built-in floating disk and renewable seat in vacuum breaker body.
- D. Distilled or Deionized Water Fixture:
1. Deck mounted.
 2. Gooseneck spout with handle arranged for self closing and with hold open feature to open and close an inert silicone diaphragm valve.
 3. Faucet designed to be chemically inert and resistant to leaching of inorganic contaminants, enhancement of bacteria growth, and internal corrosion.
- E. Eye and Face Wash Unit Pull-Out-Type:
1. Deck mounted.
 2. Designed for vandal resistant push-down control valve and 6 foot hose.
 3. Eye and face wash head, provide a soft stream for flushing action.
 4. Valve, when opened; remain open until manually closed.
- F. Eye and Face Bath, Counter Mounted:
1. Stainless Steel circular or oval shaped self rimmed sink, as shown on drawings.
 2. Two fully enclosed rubber bound spray heads to provide an aerated flow of water simultaneously into both eyes and across face.
 3. Push-pull hand operated valve.
 4. Volume regulator for each spray.
- G. Manifold, Tube-Washing:
1. Deck mounted
 2. Three valved outlet, plus one bleeder outlet.

3. Vacuum breaker, and loose key stops with integral check valve.
- H. Vanity or Lavatory Faucets in Methyl Methacrylic Polymer tops:
 1. Extra long center set single lever handle control.
 2. Cast or wrought copper alloy, vandal resistant.
 3. Stainless steel ball type with replaceable non-metallic seats, stainless steel lined sockets.
 4. Handle always returning to the neutral position or cartridge body construction.
 5. Provide laminar flow control device.

2.5 FUEL GAS, LABORATORY AIR AND LABORATORY VACUUM FIXTURES

- A. Comply with criteria for faucets except as specified.
- B. Needle valves with stainless steel replaceable cone and valve seat.
- C. Provide valve with a bonnet with exterior packing and packing gland designed to permit valve to be repacked while under pressure.
- D. Valves withstand a minimum pressure of 700 kPa (100 psi) without leakage.
- E. Equip valves with four-arm handles and serrated hose ends. Do not provide laminar flow control device.
- F. Provide duplex fixtures except where otherwise shown.
- G. Factory assembled and tested.

2.6 FIXTURE IDENTIFICATION

- A. Code fixtures with full view plastic index buttons.
- B. Use following colors and codes:

SERVICE	COLOR	CODE	COLOR OF LETTERS
Cold Water	Dark Green	CW	White
Hot Water	Red	HW	White
Laboratory Air	Orange	AIR	Black
Fuel Gas	Dark Blue	GAS	White
Laboratory Vacuum	Yellow	VAC	Black
Distilled Water	White	DW	Black
Deionized Water	White	DI	Black
Oxygen	Light Green	OXY	White
Hydrogen	Pink	H	Black
Nitrogen	Gray	N	Black
All Other Gases	Light Blue	CHEM.SYM.	Black

2.7 ELECTRICAL RECEPTACLES

- A. Hospital grade per electrical specifications.

B. Curb Mounted Receptacles:

1. NEMA 5-20R duplex in galvanized steel box.
2. Chromium plated brass or steel face plate.

C. Pedestal Mounted Receptacles:

1. NEMA 5-20R duplex installed in double faces.
2. Polished stainless steel or aluminum, or chromium plated brass pedestal.

2.8 ELECTRIC DROP-IN HOTPLATE (RANGE) UNITS

A. Built-in type units in stainless steel exposed surfaces.

B. Verify electrical characteristics at the point of connection.

C. Smooth flat cooking surfaces.

D. Metal sheath type heating units having removable heating elements and drip pans, protected terminals or lead wires with protected splices for connections and means for positive grounding.

1. No open seams or holes in metal sheath and made of material that will not scale or crack at temperatures reached in service.
2. Resistance wire: Uniformly spaced coil of nickel chromium alloy wire insulated from sheath by dense compaction of insulating material.
3. Terminals or lead wires suitable for rating of units.

E. Heating Units:

1. Double units rated not less than 2600 watts per unit.
2. Not more than 200 mm (8 inches) in diameter.
3. Capable of bringing four quarts of cold water to boil in six minutes.

F. Separate Control Unit:

1. Suitably attached and prewired to range unit.
2. Separate switch for each heating unit.
 - a. Commercial quality, rotatable in either direction through 360 degrees.
 - b. At least three heat levels.
3. Operating dials for switches clearly marked to indicate control positions and easily visible in ordinary light.
4. Control unit front removable.

- G. Indicating light assembly
 - 1. Mounted on the Control Unit Front.
 - 2. Red lens and high brightness neon glow type lamp with resistor suitably for 25,000 hours average life.
- H. Fuses and Circuit Breakers:
 - 1. Easily accessible from front of cabinet.
 - 2. Do not locate at back of storage or where articles can be stored in the front.
- I. Range and Control Units Concealed Surfaces:
 - 1. Made of materials suitable for the intended use.
 - 2. Low carbon steel galvanized or other suitable corrosion resistant finish.
 - 3. Provide a solid 1.5 mm (0.0598 inch) thick sheet steel barrier below the unit, located a minimum of nine inches below the unit top.

2.9 FILM VIEWER

- A. Designed for flush mounting in countertop.
- B. Translucent or opalescent panel 400 mm by 500 mm (16 inch by 20 inch).
- C. Minimum of three 15 watt or two 20 watt fluorescent tubes in UL listed enclosure.
- D. Provide "on-off" switch for fluorescent tube for front panel of cabinet.

2.10 COUNTERTOPS

- A. Fabricate in largest sections practicable.
- B. Fabricate with joints flush on top surface.
- C. Fabricate countertops to overhang front of cabinets and end of assemblies 25 mm (one inch) except where against walls or cabinets.
- D. Provide 1 mm (0.039 inch) thick metal plate connectors or fastening devices (except epoxy resin tops).
- E. Join edges in a chemical resistant waterproof cement or epoxy cement, except weld metal tops.
- F. Fabricate with end splashes where against walls or cabinets.
- G. Splash Backs and End Splashes:
 - 1. Not less than 19 mm (3/4 inch) thick.
 - 2. Height 100 mm (4 inches) unless noted otherwise.

3. Laboratories and pharmacy heights or where fixtures or outlets occur: Not less than 150 mm (6 inches) unless noted otherwise.
 4. Fabricate epoxy splash back in maximum lengths practical of the same material.
- H. Drill or cutout for sinks, and penetrations.
1. Accurately cut for size of penetration.
 2. Cutout for VL 81 photographic enlarger cabinet.
 - a. Finish cutout to fit flush with vertical side of cabinet, allowing adjustable shelf to fit into cutout space of cabinet at counter top level. Finish cutout surface as an exposed edge.
 - b. Provide braces under enlarger space to support not less than 45 kg (100 pounds) centered on opening side along backsplash.
- I. Plastic Laminate Countertops:
1. Fabricate plastic laminate on five-ply plywood or particleboard core 19 mm (3/4 inch) thick with plastic laminate backing sheet.
 2. Front edge over cabinets not less than 38 mm (1-1/2 inches) thick except where plastic "T" insert is used, not less than 19 mm (3/4 inch) thick.
 3. Exposed Surface and edges of decorative laminated plastic or laboratory chemical resistant surface.
 - a. Use chemical resistant surface on tops 6A, 6B, and 6C.
 - b. Use decorative surface tops when noted plastic laminate, for tops 10A, 10B and 10C.
- J. Metal Counter Tops:
1. Fabricate up to 3600 mm (12 feet) long in one piece, including nosing, backs and ends.
 2. When counter tops exceed 3600 mm (12 feet) in length accurately fitted field joints are acceptable.
 3. Finish thickness at edges 32 mm (1-1/4 inch).
 4. Reinforced with minimum 1.5 mm (0.0598 inch) thick hat channel stiffeners, minimum of two stiffeners for units without sinks and three stiffeners for units with sinks welded or soldered to underside of top full length, except at sink openings.
 5. Apply sound deadening material on underside.
 6. Flange edges of tops down 32 mm (1-1/4 inch) and reinforce with concealed hardwood or with a steel frame.

7. Grind welds smooth and finished on exposed surfaces to match finish specified.
8. Stainless Steel Counter or Sink Tops:
 - a. Where noted stainless steel except where specified for nourishment unit, unit kitchen, and medicine cabinet.
 - b. Use 1.5 mm (0.0598 inch) thick stainless steel.
 - c. Depth of splash backs and splash ends 25 mm (one inch) and turned down at least 13 mm (1/2 inch) at wall. Where faucets are located in splash backs, fabricate depth of splash backs 50 mm (2 inches) with provision made to receive required fixture.
 - d. Where sinks occur fabricate top with 5 mm (3/16 inch) marine edge and fit flush with adjacent tops of other materials.
 - e. Weld sink flush to counter top and finish to appear seamless.
- K. Molded Resin Tops:
 1. Molded resin with drip groove cut on underside of overhanging edge.
 2. Finish thickness of top minimum 25 mm (1 inch).
 3. Joints: Epoxy Type.
 4. Secure reagent shelves to counter tops with fasteners from underside and seal seam.
- L. Maple tops:
 1. Fabricate in one piece of solid laminated tongue and groove maple strips, not more than three inches in width, glued under pressure to a thickness 45 mm (1-3/4 inches).
 2. Edges and ends of clear maple wood. Make splash backs and splash ends of 19 mm (3/4 inch) thick maple and secure to counter tops with concealed metal fasteners and with contact surfaces set in waterproof glue.
 3. Round exposed edges of maple tops and backs to approximate 9 mm (3/8 inch) radius.
 4. Sand exposed surfaces smooth and even and apply two coats of boiled linseed oil. Rub in each coat and allow 48 hours to lapse between coats.
- M. Laboratory Shelf 200 mm (8 inches) deep: Fabricate of 27 mm (1-1/16 inch) thick hardwood. Finish with black acid resisting enamel.
- N. Laboratory Shelf with Funnel and Graduate Rack 300 mm (12 inches) deep shelf: Fabricate of 27 mm (1-1/16 inch) thick hardwood. Finish with black acid resisting enamel.

- O. Laboratory Shelf 254 mm (10 inch deep): Fabricate of corrosion resisting steel.
- P. Pegboards:
 - 1. Pegboard: Fabricate of birch with black acid resisting finish and equip with polypropylene or unfinished hardwood pegs.
 - 2. Pegboard with Funnel and Graduate Rack: Fabricate of birch with black acid resisting finish and equip with polypropylene or unfinished hardwood pegs. Support rack on steel brackets. Provide CRS gutter and drain to sink.
- Q. Methyl Methacrylic Polymer Tops:
 - 1. Fabricate countertop of methyl methacrylic polymer cast sheet, 19 mm (3/4 inch) thick.
 - 2. Fabricate back splash and end splash to height shown.
 - 3. Fabricate skirt to depth shown.
 - 4. Fabricate with marine edge where sinks occur.
 - 5. Fabricate in one piece for full length from corner to corner up to 3600 mm (12 feet).
 - 6. Join pieces with adhesive sealant.
 - 7. Cut out countertop for lavatories, plumbing trim.
 - 8. Provide concealed fasteners and epoxy cement for anchorage of sinks to countertop.
- R. Counter Tops for Interchangeable Furniture: Counter tops, unless otherwise shown, are to be capable of vertical adjustment of 150 mm (6 inches). Fabricate tops, except CRS, in increments of units over which they fit with maximum length not to exceed 1950 mm (78 inches). Top section shall cover as many cabinet units as possible. Horizontal joints in counter tops at service strip and across depth of counter are to be watertight when in place but of a type that can be easily separated and reset when counter top is moved up or down. Fabricate CRS tops in maximum lengths practicable, with field joints welded and ground smooth to match adjacent surfaces. Securely fasten to supporting rails with heavy metal fastening devices, or with screws, through pierced slots in such rails. Fabricate vertical splash back and reagent shelf in maximum length practicable of same material as working surface, except finish thickness shall be 19 mm (3/4 inch).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installing countertops verify that wall surfaces have been finished as specified and that mechanical and electrical service locations are as required.

- B. Secure countertops to supporting rails of cabinets with metal fastening devices, or screws through pierced slots in rails.
 - 1. Where type, size or spacing of fastenings is not shown or specified, submit shop drawings showing proposed fastenings and method of installation.
 - 2. Use round head bolts or screws.
 - 3. Use epoxy or silicone to fasten the epoxy resin countertops to the cabinets.
 - 4. Use wood or sheet metal screws for wood or plastic laminate tops; minimum penetration into top 16 mm (5/8 inch), screw size No 8, or 10.
- C. Rubber Moldings:
 - 1. Where shown install molding with butt joints in horizontal runs and mitered joints at corners where ceramic tile occurs omit molding.
 - 2. Fasten molding to wall and to splashbacks and splashends with adhesive.
- D. Sinks
 - 1. Install stainless steel sink in plastic laminate tops with epoxy compound to form watertight seal under shelf rim.
 - a. In laboratory and pharmacy fit stainless steel sink with overflow standpipe.
 - b. Install faucets and fittings on sink ledges with watertight seals where shown.
 - 2. Install molded resin sinks with epoxy compound to form watertight seal with underside of molded resin top.
 - a. Install sink with not less than two channel supports with threaded rods and nuts at each end, expansion bolted to molded resin top.
 - b. Design support for a twice the full sink weight.
 - c. Install with overflow standpipes.
 - 3. Install methyl methacrylic polymer sinks in manufacturers recommended adhesive sealer or epoxy compound to underside of methyl methacrylic polymer countertop.
 - a. Bolt or screw to countertop to prevent separation of bowl and fracture of adhesive sealant joint.
 - b. Install drain and traps to sink.
- E. Faucets, Fixtures, and Outlets:
 - 1. Seal opening between fixture and top.
 - 2. Secure to top with manufacturers standard fittings.

F. Range Tops, Electrical Outlets, Film Viewer:

1. Set in cutouts with manufacturers gasket sealing joint with top to prevent water leakage.
2. Install control unit and electric outlets where shown. Seal escutcheon plate at lap if on counter or top to prevent water leakage.

3.2 PROTECTION AND CLEANING

- A. Tightly cover and protect against dirt, water, and chemical or mechanical injury.
- B. Clean at completion of work.

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SECTION 13 05 41

SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Provide seismic restraint in accordance with the requirements of this section in order to maintain the integrity of nonstructural components of the building so that they remain safe and functional in case of seismic event.
- B. Definitions: Non-structural building components are components or systems that are not part of the building's structural system whether inside or outside, above or below grade. Non-structural components of buildings include:
 - 1. Architectural Elements: Facades that are not part of the structural system and its shear resistant elements; cornices and other architectural projections and parapets that do not function structurally; glazing; nonbearing partitions; suspended ceilings; stairs isolated from the basic structure; cabinets; bookshelves; medical equipment; and storage racks.
 - 2. Electrical Elements: Power and lighting systems; substations; switchgear and switchboards; auxiliary engine-generator sets; transfer switches; motor control centers; motor generators; selector and controller panels; fire protection and alarm systems; special life support systems; and telephone and communication systems.
 - 3. Mechanical Elements: Heating, ventilating, and air-conditioning systems; medical gas systems; plumbing systems; sprinkler systems; pneumatic systems; boiler equipment and components.
 - 4. Transportation Elements: Mechanical, electrical and structural elements for transport systems, i.e., elevators and dumbwaiters, including hoisting equipment and counterweights.

1.2 QUALITY CONTROL:

- A. Shop-Drawing Preparation:
 - 1. Have seismic-force-restraint shop drawings and calculations prepared by a professional structural engineer experienced in the area of seismic force restraints. The professional structural engineer shall be registered in the state where the project is located.
 - 2. Submit design tables and information used for the design-force levels, stamped and signed by a professional structural engineer registered in the State where project is located.
- B. Coordination:

1. Do not install seismic restraints until seismic restraint submittals are approved by the Resident Engineer.
2. Coordinate and install trapezes or other multi-pipe hanger systems prior to pipe installation.

1.3 SUBMITTALS:

- A. Submit a coordinated set of equipment anchorage drawings prior to installation including:
 1. Description, layout, and location of items to be anchored or braced with anchorage or brace points noted and dimensioned.
 2. Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, bolts, welds etc. clearly identified and specified.
 3. Numerical value of design seismic brace loads.
 4. For expansion bolts, include design load and capacity if different from those specified.
- B. Submit prior to installation, a coordinated set of bracing drawings for seismic protection of piping, with data identifying the various support-to-structure connections and seismic bracing structural connections, include:
 1. Single-line piping diagrams on a floor-by-floor basis. Show all suspended piping for a given floor on the same plain.
 2. Type of pipe (Copper, steel, cast iron, insulated, non-insulated, etc.).
 3. Pipe contents.
 4. Structural framing.
 5. Location of all gravity load pipe supports and spacing requirements.
 6. Numerical value of gravity load reactions.
 7. Location of all seismic bracing.
 8. Numerical value of applied seismic brace loads.
 9. Type of connection (Vertical support, vertical support with seismic brace etc.).
 10. Seismic brace reaction type (tension or compression). Details illustrating all support and bracing components, methods of connections, and specific anchors to be used.
- C. Submit prior to installation, bracing drawings for seismic protection of suspended ductwork and suspended electrical and communication cables, include:

1. Details illustrating all support and bracing components, methods of connection, and specific anchors to be used.
 2. Numerical value of applied gravity and seismic loads and seismic loads acting on support and bracing components.
 3. Maximum spacing of hangers and bracing.
 4. Seal of registered structural engineer responsible for design.
- D. Submit design calculations prepared and sealed by the registered structural engineer specified above in paragraph 1.3A.
- E. Submit for concrete anchors, the appropriate ICBC evaluation reports, OSHPD pre-approvals, or lab test reports verifying compliance with OSHPD Interpretation of Regulations 28-6.

1.4 APPLICABLE PUBLICATIONS:

- A. The Publications listed below (including amendments, addenda revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
- 355.2-07.....Qualification for Post-Installed
Mechanical Anchors in Concrete and
Commentary
- C. American Institute of Steel Construction (AISC):
Load and Resistance Factor Design, Volume 1, Second Edition.
- D. American Society for Testing and Materials (ASTM):
- A36/A36M-05.....Standard Specification for Carbon
Structural Steel.
- A53/A53M-07.....Standard Specification for Pipe, Steel,
Black and Hot-Dipped, Zinc-Coated, Welded
and Seamless.
- A307 (REV A-07).....Standard Specification for Carbon Steel
Bolts and Studs; 60,000 PSI Tensile
Strength.
- A325-07.....Standard Specification for Structural
Bolts, Steel, Heat Treated, 120/105 ksi
Minimum Tensile Strength.
- A325M-05.....Standard Specification for High-Strength
Bolts for Structural Steel Joints
[Metric].
- A490-06.....Standard Specification for Heat-Treated
Steel Structural Bolts, 150 ksi Minimum
Tensile Strength.

- A490M (REV A-04).....Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric].
- A500/A500M-07.....Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- A501-07.....Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- A615/A615M-07.....Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- A992/A992M (REV A-06)...Standard Specification for Steel for Structural Shapes for Use in Building Framing.
- A996/A996M (REV A-06)...Standard Specification for Rail-Steel and Axel-Steel Deformed Bars for Concrete Reinforcement.
- E488-96(R2003).....Standard Test Method for Strength of Anchors in Concrete and Masonry Elements.
- E. International Building Code (IBC) 2003 Edition.
- F. VA Seismic Design Requirements, H-18-8, December 2003.
- G. National Uniform Seismic Installation Guidelines (NUSIG).
- H. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

Seismic Restraint Manual - Guidelines for Mechanical Systems, 1998 Edition and Addendum.

1.5 REGULATORY REQUIREMENT:

- A. IBC 2009.

PART 2 - PRODUCTS

2.1 STEEL:

- A. Structural Steel: ASTM A36 and A992.
- B. Structural Tubing: ASTM A500, Grade B.
- C. Structural Tubing: ASTM A501.
- D. Steel Pipe: ASTM A53/A53M, Grade B.
- E. Bolts & Nuts: ASTM A307, A325, and A490.

2.2 CAST-IN-PLACE CONCRETE:

- A. Concrete: 28 day strength, $f'c = 25 \text{ MPa}$ (3,000 psi).
- B. Reinforcing Steel: ASTM A615/615M or ASTM A996/A996M deformed.

PART 3 - EXECUTION

3.1 CONSTRUCTION, GENERAL:

- A. Provide equipment supports and anchoring devices to withstand the seismic design forces, so that when seismic design forces are applied, the equipment cannot displace, overturn, or become inoperable.
- B. Provide anchorages in conformance with recommendations of the equipment manufacturer and as shown on approved shop drawings and calculations.
- C. Construct seismic restraints and anchorage to allow for thermal expansion.
- D. Testing Before Final Inspection:
 - 1. Test 10-percent of anchors in masonry and concrete per ASTM E488, and ACI 355.2 to determine that they meet the required load capacity. If any anchor fails to meet the required load, test the next 20 consecutive anchors, which are required to have zero failure, before resuming the 10-percent testing frequency.
 - 2. Before scheduling Final Inspection, submit a report on this testing indicating the number and location of testing, and what anchor-loads were obtained.

3.2 EQUIPMENT RESTRAINT AND BRACING:

- A. See drawings for equipment to be restrained or braced.

3.3 MECHANICAL DUCTWORK AND PIPING; BOILER PLANT STACKS AND BREACHING; ELECTRICAL BUSWAYS, CONDUITS, AND CABLE TRAYS; AND TELECOMMUNICATION WIRES AND CABLE TRAYS

- A. Support and brace mechanical ductwork and piping; electrical busways, conduits and cable trays; and telecommunication wires and cable trays including boiler plant stacks and breeching to resist directional forces (lateral, longitudinal and vertical).
- B. Brace duct and breeching branches with a minimum of 1 brace per branch.
- C. Provide supports and anchoring so that, upon application of seismic forces, piping remains fully connected as operable systems which will not displace sufficiently to damage adjacent or connecting equipment, or building members.
- D. Seismic Restraint of Piping:
 - 1. Design criteria:
 - a. Piping resiliently supported: Restrain to support 120-percent of the weight of the systems and components and contents.

- b. Piping not resiliently supported: Restrain to support 60 -percent of the weight of the system components and contents.
- E. Piping Connections: Provide flexible connections where pipes connect to equipment. Make the connections capable of accommodating relative differential movements between the pipe and equipment under conditions of earthquake shaking.

3.4 PARTITIONS

- A. In buildings with flexible structural frames, anchor partitions to only structural element, such as a floor slab, and separate such partition by a physical gap from all other structural elements.
- B. Properly anchor masonry walls to the structure for restraint, so as to carry lateral loads imposed due to earthquake along with their own weight and other lateral forces.

3.5 CEILINGS AND LIGHTING FIXTURES

- A. At regular intervals, laterally brace suspended ceilings against lateral and vertical movements, and provide with a physical separation at the walls.
- B. Independently support and laterally brace all lighting fixtures. Refer to applicable portion of lighting specification, Section 26 51 00, INTERIOR LIGHTING.

3.6 FACADES AND GLAZING

- A. Do not install concrete masonry unit filler walls in a manner that can restrain the lateral deflection of the building frame. Provide a gap with adequately sized resilient filler to separate the structural frame from the non-structural filler wall.
- B. Tie brick veneers to a separate wall that is independent of the steel frame as shown on construction drawings to ensure strength against applicable seismic forces at the project location.
- C. Install attachments to structure for all façade materials as shown on construction drawings to ensure strength against applicable seismic forces at the project location.

3.7 STORAGE RACKS, CABINETS, AND BOOKCASES

- A. Install storage racks to withstand earthquake forces and anchored to the floor or laterally braced from the top to the structural elements.
- B. Anchor medical supply cabinets to the floor or walls and equip them with properly engaged, lockable latches.
- C. Anchor filing cabinets that are more than 2 drawers high to the floor or walls, and equip all drawers with properly engaged, lockable latches.
- D. Anchor bookcases that are more than 30 inches high to the floor or walls, and equip any doors with properly engaged, lockable latches.

- - - E N D - - -

SECTION 14 58 10

PNEUMATIC TUBE SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Furnish all engineering, materials and labor for the computer controlled pneumatic tube distribution system and alteration of the existing system control center. The System shall be manufactured and installed by TransLogic Corporation, or equal.
- B. All work shall be completed in a workmanlike manner, complete in all respects, including all items specified herein and as may be necessary for the satisfactory installation and operation of the specified system.
- C. The types and locations of the stations in this specification shall be as indicated on the drawings and shall be in strict accordance with the standards established by the Contractor.
- D. The Contractor shall work with the General Contractor and all trades to ensure coordination for System right-of-way.

1.2 QUALITY ASSURANCE:

- A. The Contractor shall regularly and presently manufacture, install and warrant the computer controlled material distribution equipment as specified herein as one of their principle products. The equipment furnished shall be the product of the Contractor and shall be installed by skilled mechanics under direct employment and supervision of the Contractor. No third party substitutions shall be involved in design, layout, installation, warranty efforts or service offerings. The Contractor shall have a quality assurance program in place, demonstrable to the Owner.
- B. The Contractor shall be fully responsible for the manufacture, installation and guarantee of the specified System.
- C. The Contractor shall maintain a training facility that shall include the specified equipment installed and operational for comprehensive hands-on maintenance instruction of Owner maintenance personnel. The training facility shall be separate from the Contractor's manufacturing or development areas to prevent interruptions during the training process.
- D. The Contractor shall have a service branch within 100 miles of the installation, and shall provide service within 24 hours of a call.
- E. The Contractor shall maintain a 24 hour, 7 day per week toll-free phone number for contacting maintenance personnel who are factory trained in the specified System. Response shall be 3 hours or less.
- F. All electrical equipment shall be listed with Underwriter's Laboratory (UL) and all field wiring shall be in conformance with NEC requirements and local codes. UL listing shall be for all assemblies and components of assemblies. UL listing must be current.

1.3 WORK INCLUDED IN THIS SECTION:

- A. The Contractor shall furnish and install all motor starters with properly sized thermal overload protection in each phase at the blower packages.

1.4 WORK NOT INCLUDED IN THIS SECTION:

- A. Items described herein relate to the installation of the System, but are excluded from this section of the specification. The Contractor shall provide information as required to perform the work.
- B. General items.
 - 1. Supply and installation of architectural enclosures for equipment as specified on the contract drawings or shop drawings.
 - 2. Equipment fur-in to match existing surroundings.
 - 3. A clear and unobstructed right-of-way space for System equipment.
 - 4. Cutting, patching or painting.
 - 5. Removal, repair or replacement of existing ceilings or walls to match existing surroundings.
 - 6. Removal, relocation and/or replacement of other mechanical equipment, fixtures, conduit, pipe, etc.
 - 7. Hole cutting and sleeve setting in floors and walls.
 - 8. Patching/fireproofing of sleeves and openings in floors, walls and ceilings where required.
 - 9. Supply and installation of access panels where specified on contract drawings and/or shop drawing submittals.
 - 10. Painting of exposed tube and unfinished exposed surfaces where required.
 - 11. Unloading, safe, dry and adequate storage space for materials on the job site during construction.
 - 12. Elevator services for equipment and personnel during construction.
 - 13. Dust protection if required.
 - 14. Sealing of sprayed fire-retarding insulation in close proximity to any System equipment.
 - 15. Cleaning of all plaster, mortar, paint, and other debris in or on the System equipment resulting from other trades.
 - 16. Repairing, replacing or repainting of equipment damaged by other trades.

17. A control center environment of 0% to 95% relative humidity and an ambient temperature of 10 degrees C to 40 degrees C.
 18. A dedicated DID (direct inward dial) analog phone line and jack within 5' of the system control center.
- C. Electrical items:
1. A 115 VAC single phase, 50/60 Hz power supply wired to terminals in a factory installed duplex receptacle within each station, transfer unit and blower package.
 2. A local 105 to 125 VAC, single phase, 50/60 Hz dedicated power source to a duplex receptacle within 5' of the system control center.
 3. Temporary power to facilitate testing when required.
- D. Hazardous Materials:
1. Identification of all areas with unabated asbestos.
 2. All inspections, testing, monitoring, abatement and containment for any hazardous material including asbestos, which is encountered anytime in the duration of the project.

1.5 SUBMITTALS

- A. Shop drawings which show tube routings on architectural floor plans, tubing riser diagram, electrical riser diagram, right-of-way, methods of suspending and anchoring tubing, station details, equipment locations and detailed dimensions of all major components. Tube routings shall be shown on owner-supplied architectural floor plan backgrounds in AutoCAD release 13.0 or higher.
- B. Contractor's marked literature showing illustrations, data and description of system to be furnished.

1.6 WARRANTY

- A. The Contractor shall guarantee all components to be free from defects in material and workmanship, under normal use, for a period of 12 months.
- B. Defective material shall be repaired or replaced at the discretion of the Contractor, free of charge.
- C. Specifically excluded from this warranty are failures resulting from normal wear, improper operation, improper maintenance or lack of prescribed owner preventive maintenance of the system.
- D. Signed acceptance or use of the System by the Owner shall commence the warranty period.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. The System is an existing CTS-30 VLP computer controlled pneumatic tube materials distribution system consisting of tubing, stations, transfer units, blower packages, carriers and a control center.

- B. The System shall be configured of groups of stations (zones) connected together by interzone tubes. Each station shall be connected to the System by a single tube to a transfer unit.
- C. Each zone shall include a blower and function independently.
- D. The dispatching, routing, and storage of carriers shall be directed by the system control center to provide automatic unattended transmission of carriers between any two stations.
- E. The System shall provide shortest route vacuum-pressure travel. Transactions within a zone shall turn around at the nearest transfer unit common to the origin and destination stations.
- F. To dispatch a carrier from a station, the operator shall place the latched carrier in the dispatcher, select the destination address and press the "Send" push-button at the station.
- G. Systems with more than one zone shall allow multiple carriers to be in transit simultaneously. The System shall allow all station dispatchers to be loaded simultaneously, destinations to be selected and all transactions processed automatically until the System is clear.
- H. The work shall consist of the addition of two (2) new stations and relocation of the existing control center.
- I. The System shall provide for a minimum capacity of 996 units on 32 zones without the need to modify or replace existing equipment. Additions shall require no modifications to existing equipment.
- J. The modular design of the System components shall permit changes in the number of stations and/or zones as Owner requirements change.
- K. The System shall provide automatic empty carrier redistribution. The System shall enable operators to dispatch excess empty carriers to carrier-deficient stations which shall be automatically identified and selected by the System. The need shall be determined by the ratio of carriers assigned to carriers present taking into account carriers in transit to the station, carriers queued for dispatch to the station and carriers queued for dispatch from the station.
- L. Individual stations or zones shall be able to be shut down without affecting the remainder of System.
- M. Destinations which are unavailable (non-existing, full, out-of-service) shall be rejected at the origination station. Prior to dispatch the route to the destination station shall be checked twice to ensure that all sections of the System involved in the transaction are operating properly.
- N. A transaction to a station that becomes unavailable after dispatch shall be rerouted to the origin station.
- O. Transactions in process or pending when any part of the System is signed off shall deliver to their destinations. Any new requests to send shall be rejected.

- P. If a power failure occurs, the system will continue to process carriers under UPS power and an advisory will be posted at the SCC. If UPS voltage drops below a programmable threshold, a second message will be posted at the SCC monitor and the system will automatically switch to Quick-off. All in-transit carriers will be processed to their destinations and all pending transactions will be cancelled.
- Q. If power fails at a blower, transfer unit or station, the controls will identify that device as unavailable voiding all transactions which involve the affected device.
- R. Each station shall be able to be individually assigned up to ten scheduled events per day including; on/off times, send and receive priorities, carrier forwarding on/off and quantity of assigned carriers.
- S. Station sending and receiving and System priorities shall ensure that carriers are processed to their destinations in the shortest time.
- T. Closed loop control shall verify via feedback loops that a command to a System component is properly executed before the next segment of the transaction is initiated.
- U. A 115 VAC duplex receptacle and device on/off switch shall be provided at each station, transfer unit and blower package.
- V. The destinations available at each station shall be individually configurable at the system control center.
- W. Stations shall be able to be individually scheduled to be able to dispatch but not receive carriers.
- X. Each station, transfer unit and blower shall include diagnostic capability at the unit.

2.2 EQUIPMENT

- A. Line material:
 - 1. Tubing shall be 6" outside diameter, 16 gauge, cold rolled, electric welded steel, flash removed, degreased and hot dip galvanized.
 - 2. Bends shall be formed of same material on a center line radius of not less than 48 inches. The cross-section shall be free from wrinkles and distortions. No expanded bends shall be allowed in the System.
 - 3. All cut ends shall be square, deburred and mandreled round.
 - 4. Solid steel slip sleeves or split steel gasketed bolted sleeves shall be used for tubing joints. Split sleeves shall be used at all connections of serviceable equipment. All sleeves shall be of the same gage as the tubing.
 - 5. Slip joints shall be sealed with a suitable airtight compound.

6. Tubing shall be supported with suitable hangers and supports as follows:
 - a. Minimum every ten (10) feet of straight tubing,
 - b. At every floor of vertical runs,
 - c. At each end of each bend,
 - d. At equipment connections, and
 - e. At the center of the bend radius with sway bracing.
7. Hangers shall be pre-threaded, zinc plated rod attached to the building structure. Tube clamps or channels fastened to the rod shall support the tubing.

B. Transfer Units:

1. Transfer units enable a transmission tube connection from one tube to any one of several tubes, providing the tubing network for routing carriers between stations.
2. Transfer units shall be installed with split sleeves and sway braced against motion.
3. Transfer units shall be located to allow for complete and clear access to service mechanical and electrical components.
4. The offset through the transfer unit shall be gradual using a curved tube section.
5. All transfer units component position sensing and carrier sensing shall be by non-contact sensors.
6. All visible metal surfaces shall be factory painted with an electrostatically applied, baked-on, powder coat epoxy.
7. Transfer units shall be provided as required in 1 to 2 ports, 1 to 4 ports and 1 to 6 ports.

C. Stations:

1. Stations shall consist of dispatch equipment, receive equipment and electrical controls enclosed in a sheet metal housing.
2. Stations shall be up send, down receive.
3. All mechanical and electrical components shall be front accessible and removable for repair or replacement.
4. Electronic control units shall be solid state plug-in type for fast replacement and shall be interchangeable with units in other stations.
5. All component position sensing and carrier sensing shall be by non-contact sensors.

6. All visible metal surfaces shall be factory painted with an electrostatically applied, baked-on, powder coat epoxy. Bright metal finish parts shall be stainless steel, brushed aluminum or chrome plated.
7. The dispatcher shall hold one carrier at a time.
8. The receiver shall be independent of the dispatcher.
9. The dispatcher shall enable a carrier to be staged for dispatch while a carrier is incoming to a station.
10. When station's receiver becomes full that station's receive and dispatch functions shall be disabled. A message on the station display and at the system control center shall indicate the full condition. The condition shall automatically reset upon carrier removal from receiver.
11. Stations shall provide air-cushioned carrier arrival at the receive slidegate.
12. Stations shall be capable of dispatching a seven pound payload. Station at Pharmacy shall include a full capacity dispatcher to handle dispatch payloads of up to 15 pounds.
13. Each station shall be equipped with one modular operator control panel per dispatcher.
 - a. The I.Q. operator control panel shall include a membrane keypad for destination and special function selection.
 - b. A liquid crystal display panel (LCD) with up to 8 lines of 40 characters each for message display. The LCD panel shall display:
 - 1) The last six destination selections.
 - 2) Help menu selections.
 - 3) A directory of stations.
 - 4) Special functions.
 - 5) Operator feedback information.
 - c. "Up" and "Down" arrow keys for scrolling through the LCD displays.
 - d. A "Send/Enter" key to activate the dispatch after destination selection or to enter data for special functions.
 - e. A "Cancel/Clear" key to allow for transaction cancellation or clearing of the display during special function activation.
 - f. An "Empty Send" key for surplus carrier redistribution.

- g. A "Call Carrier" key to have the next redistributed carrier directed to this station.
- h. A "Track Carrier" key to track a transaction.
- i. Up to six LED's for RPI visual indication..
- j. Twelve programmable keys all of which can be used for one button addressing of high traffic stations or up to six of which can be used for resetting RPI's.
 - 1) Keys shall be individually programmable per station.
 - 2) The RPI audible signal can be rest at the RPI. The station and RPI LED's are reset at the station.
- k. A "Returned Carrier" LED to signal that a transaction was unable to be completed and the carrier was returned to its origin station.
- l. A "Menu" key for selecting special functions.
 - 1) Stat Transaction
 - 2) Secure Transaction
 - 3) Assign Carriers Present
 - 4) Traffic Forwarding
 - 5) Emergency Shutdown
 - 6) Incoming Carrier Query
 - 7) Station On/Off
 - 8) Carrier Inventory Adjustment
 - 9) Station Diagnostics
 - 10) Audible Carrier Arrival
 - 11) Audible Surplus Carriers
 - 12) Audible Full Station
 - 13) A directory of station addresses.
- 14. Instructions for operating the station and special functions.
- 15. Discrete rejection messages to indicate:
 - a. Dispatching station off
 - b. Dispatching station not in service
 - c. Selection full - try later

- d. Selection does not exist
- e. Selection scheduled off
- f. Selection signed off
- g. Selection not in service
- h. Selection is secured
- i. Selection not permitted

16. LCD message capability for the following conditions:

- a. A carrier is incoming to the station.
- b. The station carrier count exceeds its assigned number, return surplus carriers.
- c. The station is full, remove carriers from receiver.
- d. The station is not receiving carriers, traffic is forwarded to another station.

D. Recessed single dispatcher stations:

- 1. Recessed single dispatcher stations shall include one dispatch chamber and an integral receive bin. The receive bin shall provide open storage nominally for four carriers.
- 2. The station shall be designed to be wall recessed enabling all non-operator accessible equipment to be concealed behind walls. A trim frame shall be provided to conceal the joint between the wall and the station housing.
- 3. To minimize damage, stations shall be installed in two phases; a housing in the initial stages of construction, and a mechanical/electrical finish kit after construction work in the area is substantially complete.
- 4. Recessed stations shall be located at Room 0436B.

E. Recessed multiple dispatcher (Ultra Station):

- 1. Recessed multiple dispatcher stations shall include 2 complete dispatcher/receiver assemblies and connected to two (2) separate zones and an integral receive bin. The station shall have a capacity for up to four complete dispatcher/receivers. The receive bin shall provide open storage nominally for 12 carriers.
- 2. The station shall be compact and designed to be wall recessed enabling all non-operator accessible equipment to be concealed behind walls. A trim frame shall be provided to conceal the joint between the wall and the station housing.
- 3. To minimize damage, stations shall be installed in two phases; a housing in the initial stages of construction, and a mechanical/electrical finish kit after construction work in the area is substantially complete.

F. Carriers and liners:

1. Sealed carriers, provide 9 sealed carriers as follows:
 - a. Clear molded plastic.
 - b. Full access side opening.
 - c. Bi-directional.
 - d. Replaceable wear bands which also serve as the hinges.
 - e. Easy open positive closure latches.
 - f. Compression gasket which seals the carrier halves when closed.
 - g. Capable of carrying: specimens, medications, x-ray film, 1,000 ml IV bags filled up to 100 cc's.
 - h. Clear inside dimensions: 4-1/2" diameter by 15-5/8" length.
2. Provide 5 thin carrier liners for cushioning large items.
3. Provide 5 full carrier liners for cushioning small items.

G. Low voltage control cable: Cable for System low voltage controls shall be plenum rated with minimum 18 gauge conductors. Cable shall be strapped to the transmission tubing at minimum 10' intervals.

H. System control center (SCC), (Existing): The system control center shall consist of a computer, monitor, keyboard, uninterruptible power supply, printer and software.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The System and components shall be assembled and installed in strict accordance with contract documents, applicable codes and regulations, approved shop drawings, and Contractor's recommendations.
- B. The System and components shall be anchored and fastened to building construction as required for a stable, secure installation. All exposed parts of the System and finish components shall be closely fit and joined to provide a neat uniform appearance.

3.2 SYSTEM TESTING AND ACCEPTANCE

- A. Prior to a formal System performance test, the Contractor shall perform preliminary tests, verifying all components are in fully operational condition for carrier dispatch and receive between all possible station combinations.
- B. The Contractor shall provide written notification to the Project Engineer thirty (30) days in advance of the scheduled System

performance test. The Contractor shall provide all personnel, equipment and instruments required for such examination.

- C. In the presence of the Project Engineer and Owner, the Contractor shall perform all operational tests, inspecting System components and verifying that the equipment is installed and operating in proper condition, according to the intent of the contract.
- D. The Owner's representative shall sign a written statement indicating that the System has been turned over and accepted by the Owner.

3.3 OPERATOR TRAINING

- A. The Contractor shall train the Owner's training staff on-site in the use and operation of the System. Training shall be provided for one person per station with a minimum of ten.
- B. The training shall include:
 - 1. A commercially prepared video tape describing the System and its capabilities and potential benefits.
 - 2. Assistance in developing the protocol policies for the Owner's use of the System.
 - 3. Review of information and standards regarding regulations of OSHA, NACCLS, CDC, etc. for transport of hazardous materials in the System.
 - 4. Containment and immobilization of items transported in the System.
 - 5. Review of common System alarms and their correction.
 - 6. Use and functions of the System.
 - 7. Package of training materials for the Owner's trainers to use.
 - 8. A decontamination/infection control procedure and a cleanout kit with procedures for cleaning liquid spills in the System.

3.4 MAINTENANCE TRAINING

- A. Maintenance personnel as assigned by the Owner shall be trained on the job site in the proper maintenance and trouble shooting of the System.
- B. The Owner shall assign at least two (2) persons to accompany Contractor start-up technicians during final System checkout procedures.
- C. A minimum four day training course shall be included at the Contractor's training facility for one person in the repair and maintenance of the System. Cost of transportation, room and board shall be provided by the Owner.

3.5 INFORMATION FORMATS

- A. The Contractor shall provide operating and maintenance information in the following formats.
 - 1. One (1) read-only CD ROM.
 - 2. One (1) paper copy manual.
 - 3. Included in the CD and manual shall be;
 - a. System components and part descriptions,
 - b. Starting and stopping procedures,
 - c. General operating instructions,
 - d. Specific maintenance and troubleshooting instructions,
 - e. Recommended service schedules for adjustment, lubrication and inspection.
 - f. Recommended spare parts inventory.
- B. The Contractor shall provide as-built shop drawings on AutoCAD release 14.0 for instruction and future reference by the Owner. If Owner-supplied architectural electronic backgrounds are not available in the design phase, three (3) sets of paper copies may be substituted.

- - - E N D - - -

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 00 72 00, GENERAL CONDITIONS.
- B. Section 01 00 00, GENERAL REQUIREMENTS.
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Excavation and Backfill: Section 31 20 00, EARTH MOVING.
- E. Concrete and Grout: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- F. Building Components for Attachment of Hangers: Section 05 31 00, STEEL DECKING or Section 05 36 00, COMPOSITE METAL DECKING.
- G. Section 05 50 00, METAL FABRICATIONS.
- H. Section 07 84 00, FIRESTOPPING.
- I. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- J. Section 07 92 00, JOINT SEALANTS.
- K. Section 09 91 00, PAINTING.
- L. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS
- M. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- O. 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: Section 00 72 00, GENERAL CONDITIONS.

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: In accordance with Section 00 72 00, GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION. Provide detailed layout drawings of all piping systems. In addition 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 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.
- D. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.

E. Valve Tags and Lists:

1. 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.

2.3 FIRESTOPPING

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

2.4 GALVANIZED REPAIR COMPOUND

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

2.5 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.

2.6 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.

2.7 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. 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.

G. 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 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.

3.3 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.

3.4 INSTRUCTIONS TO VA PERSONNEL

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

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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 portions of Building.
- C. 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 05 11 COMMON WORK RESULTS FOR FIRE SUPPRESSION

1.3 QUALITY ASSURANCE

- A. Installer Reliability: The installer shall possess a valid State of California 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 and state contractor's 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, Elevator Shafts, Elevator Machine Rooms, Refrigeration Service Rooms, Repair Shops.
 - c. Ordinary Hazard Group 2 Occupancies: Storage rooms, trash rooms, clean and soiled linen rooms, pharmacy and associated storage, laundry, kitchens, kitchen storage areas, retail stores, retail store storage rooms, storage areas, building management storage, boiler plants, energy centers, warehouse spaces, file storage areas for the entire area of the space up to 140 square meters (1500 square feet) and Supply Processing and Distribution (SPD).
 - d. Request clarification from the Government for any hazard classification not identified.
 - e. Base sprinkler design on the capacity of the fire pump
 - 5. Zoning:
 - a. For each sprinkler zone provide a control valve, flow switch and a test and drain assembly with pressure gauge.
 - b. Sprinkler zones shall conform to the smoke barrier zones shown on the drawings.
 - c. Provide seismic protection in accordance with NFPA 13.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):

13-2002.....Installation of Sprinkler Systems
101-22003.....Safety to Life from Fire in Buildings and
Structures (Life Safety Code)
170-1999.....Fire Safety Symbols

- C. Underwriters Laboratories, Inc. (UL):
Fire Protection Equipment Directory - 2001
- D. Factory Mutual Engineering Corporation (FM):
Approval Guide - 2001
- E. Uniform Building Code - 1997
- 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.
- E. Ported alarm connections on sprinkler riser valve to be piped to a retard chamber to absorb variable pressure surges. Circuit Closer to be installed on retard chamber with proper venting capabilities to eliminate vapor or hydraulic lock against circuit closer.
- F. 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. "Institutional" type sprinklers in Mental Health and Behavior Units shall be UL listed or FM approved quick response type. Maximum

break away strength shall be certified by the manufacturer to be no more than 39 kPa (85 pounds). Provide quick response sprinklers in all areas, except where specifically prohibited by their listing or approval.

- B. Temperature Ratings: In accordance with NFPA 13, except as follows:
 - 1. Sprinklers in elevator shafts, elevator pits, and elevator machine rooms: Intermediate temperature rated.
 - 2. Sprinklers in Generator Rooms: High temperature rated.

2.4 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.

2.5 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.

2.6 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.

2.10 WALL, FLOOR AND CEILING PLATES

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

2.11 ANTIFREEZE SOLUTION

Antifreeze solution shall be compatible with potable water supply in accordance with NFPA 13.

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. 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.
- I. 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.
- J. Provide pressure gauge at each water flow alarm switch location and at each main drain connection.
- K. For each fire department connection, provide the symbolic sign given in NFPA 170 and locate 2400 to 3000 mm (8 to 10 feet) above each connection location. Size the sign to 450 by 450 mm (18 by 18 inches) with the symbol being at least 350 by 350 mm (14 by 14 inches).
- L. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.
- M. MRI Suite: Provide no more than one penetration of the MRI shield enclosure. The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector.
- N. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.
- O. Repairs: Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the Government.
- P. Interruption of Service: There shall be no interruption of the existing sprinkler protection, water, electric, or fire alarm services without prior permission of the Contracting Officer. Contractor shall develop an interim fire protection program where interruptions involve in occupied spaces. Request in writing at least one week prior to the planned interruption.

3.2 INSPECTION AND TEST

- A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13, in

the presence of the Contracting Officers Technical Representative (COTR) or his designated representative. Test and flush underground water line prior to performing these hydrostatic tests.

- B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COTR/Resident Engineer to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.

3.3 INSTRUCTIONS

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

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SECTION 22 05 11
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section 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 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 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
- E. Excavation and Backfill: Section 31 20 00, EARTH MOVING.
- F. Concrete and Grout: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- G. Building Components for Attachment of Hangers: Section 05 31 00, STEEL DECKING, or Section 05 36 00, COMPOSITE METAL DECKING.
- H. Section 05 50 00, METAL FABRICATIONS.
- I. Section 07 84 00, FIRESTOPPING.
- J. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- K. Section 07 92 00, JOINT SEALANTS.
- L. Section 09 91 00, PAINTING.
- M. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS
- N. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- O. 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. 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.
 - 2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 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. Submit 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.
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. 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 (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.
- 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.

C. 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 RE/COTR for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the RE/COTR at least two weeks prior to commencing installation of any item.
2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract drawings to the RE/COTR for resolution.
3. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.

D. Guaranty: Section 00 72 00, GENERAL CONDITIONS..

1.4 SUBMITTALS

- A. Submit 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 "Group" number.
- 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, 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.
- G. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
 - 1. Submit electric motor data and variable speed drive data 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: In accordance with Section 00 72 00, GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION. Submit complete consolidated and coordinated layout drawings 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. Show the access means for all items requiring access for operations and maintenance. Do not install equipment foundations, equipment or piping until layout drawings have been approved. Provide detailed layout drawings of all piping systems. In addition 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.
- 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. 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.

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. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the RE/COTR. Such repair or replacement shall be at no additional cost to the Government.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Government.
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 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-98.....Qualifications Standard for Welding and Brazing
Procedures, Welders, Brazers, and Welding and
Brazing Operators

C. 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

D. Manufacturers Standardization Society (MSS) of the Valve and Fittings
Industry, Inc:

SP-58-93.....Pipe Hangers and Supports-Materials, Design and
Manufacture

SP 69-2003.....Pipe Hangers and Supports-Selection and
Application

E. National Electrical Manufacturers Association (NEMA):

MG1-2003, Rev. 1-2004...Motors and Generators

F. National Association of Plumbing - Heating - Cooling Contractors
(NAPHCC):

1996.....National Standard Plumbing Code

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 SAFETY GUARDS

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 breaked 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.

2.4 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.

2.5 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Valve Tags and Lists:

1. Plumbing: Provide for all valves (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: 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.

2.6 FIRESTOPPING

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 firestop pipe insulation.

2.7 GALVANIZED REPAIR COMPOUND

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

2.8 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 National Uniform Seismic Installation Guidelines (NUSIG), most current edition. Submittals based on either the NUSIG guidelines 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. Support of suspended equipment over 227 kg (500 pounds) shall be submitted for

approval of the Resident Engineer in all cases. See paragraph 2.8.M 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 (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.
- 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 23mm (7/8-inch) outside diameter.
- E. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKING. or Section 05 36 00, COMPOSITE METAL DECKING.
- F. 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 41mm by 41mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.
 - 1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
 - 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2-inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.
- I. 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

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.

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. 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.
- j. Spring Supports (Expansion and contraction of vertical piping):
 - 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.

2. Plumbing Piping (Other Than General Types):

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

J. 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.

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

2.9 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.

2.10 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.

2.11 WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.

- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. 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.

2.12 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, and equipment, access provisions, and work of all trades.. Locate piping, sleeves, inserts, hangers, 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 RE/COTR where working area space is limited.
 - 2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by RE/COTR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to RE/COTR for approval.
 - 3. Do not penetrate membrane waterproofing.

- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. 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.
- I. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE. J. 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.
- K. 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.
- 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 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.
- M. Work in Animal Research Areas: Seal all pipe penetrations with silicone sealant to prevent entrance of insects.
- N. 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.
- O. 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 Para. 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 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. 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. Plumbing horizontal and vertical pipe supports, refer to the NAPHCC National Standard Plumbing Code.
- 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. 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. 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 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 RE/COTR in unopened containers that are properly identified as to application.
- C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.6 MECHANICAL DEMOLITION

- A. Rigging access, other than indicated on the drawings, shall be provided by the Contractor 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, 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 plant, 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 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. 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. 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.

3.8 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.

3.9 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.

3.10 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.

3.9 OPERATION AND MAINTENANCE MANUALS

- A. Provide four bound copies. Deliver to RE/COTR not less than 30 days prior to completion of a phase or final inspection.
- B. Include all new and temporary equipment and all elements of each assembly.
- C. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, other data.
- D. Manufacturer's installation, maintenance, repair, and operation instructions for each device. Include assembly drawings and parts lists. Include operating precautions and reasons for precautions.
- E. Lubrication instructions including type and quantity of lubricant.
- F. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications.
- G. Set points of all interlock devices.
- H. Trouble-shooting guide for control systems.
- I. Operation of the combustion control system.
- J. Emergency procedures.

3.10 INSTRUCTIONS TO VA PERSONNEL

Provide 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. 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. 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(R1999) E1.....Ductile Iron Castings
- C. National Association of Plumbing - Heating - Cooling Contractors (PHCC):
- National Standard Plumbing Code - 1996
- D. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
- SP-67-02.....Butterfly Valve of the Single flange Type (Lug Wafer)
- SP-70-98.....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
- E. American Society of Sanitary Engineers (ASSE):
- 1013-99.....Reduced Pressure Principle Backflow Preventers
- 1015-99.....Double Check Backflow Prevention Assembly

PART 2 - PRODUCTS

2.1 VALVES

A. Asbestos packing is prohibited.

B. Shut-off:

1. Cold, Hot and Recirculating Hot Water:

a. Fifty millimeter (2 inches) and smaller:

1) Ball, Mss SP-72, SP-110, Type II, Class 125, Style 1, three piece or double union end construction, full ported, full flow, with solder end connections, 2750 kPa (400 psi) WOG, MSS-SP-67.

b. Less than 100 mm (4 inches): Butterfly, iron body, aluminum bronze disc, 416 stainless steel stem, EPDM seat, wafer design, lever operator to six 150 mm (6 inch)size, , 1375 kPa (200 pound) WOG, Fed. Spec WW-V-1967.

c. One hundred millimeters (4 inches) and larger:

1) Gate, MSS-SP-70, wedge disc, class 125, cast iron body with bronze trim, flanged, gear operated and crank for 200 mm (8 inches) and above.

2) Grooved end butterfly valves with ductile iron body and disc core ASTM A536. Disc rubber coated with compatible material for intended service, maximum working pressure 2050 kPa (300 pounds psi) grooved ends for connection with mechanical grooved couplings.

2. Reagent Grade Water: Shall be ball type of same material as used for pipe.

C. Check:

1. Less than 100 mm (3 inches) and smaller): Bronze body and trim, swing type, MSS-SP-80, 850 kPa (125 pound) WSP.

2. Larger than 100 mm (4 inches and larger):

a. Iron body, bronze trim, swing type, vertical or horizontal installation, flange connections, 1375 kPa (200 pound) WOG.

b. Ductile iron (ASTM A536) or malleable iron (ASTM A47) body, stainless steel or aluminum bronze trim, dual disc, spring loaded, non-slamming design with grooved ends for connection with mechanical grooved couplings. Consult manufacturer for appropriate elastomeric seal for intended service. Maximum working pressure 3450 kPa (500 pounds psi), depending on size.

D. Globe:

1. Eighty millimeters (3 inches) or smaller: Bronze body and bonnet, MSS-SP-80, 850 kPa (125 pound) WSP. Disk shall be free to swivel on the stem. Composition seating surface disk construction may be substituted for all metal disk construction. Packing shall be a woven non-asbestos material, impregnated with not less than 25 percent, by weight, tetrafluoroethylene resin.
2. Larger than 80 mm (3 inches): Similar to above, except with cast iron body and bronze trim.

E. Ball Valves

1. Furnish materials in accordance with State and standards.
2. 2 inches and smaller: MSS SP 110, 600 psi WOG, two piece bronze body, chrome plated brass ball, full port, Teflon seats, blow out proof stem, solder or threaded ends with union lever handles.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with the PHCC National Standard Plumbing Code and the following:
1. Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible. Install valve in each water connection to fixture.
 2. Install union and shut-off valve on pressure piping at connections to equipment.
 3. Backflow prevention device shall be installed in an accessible location, 5 (five) feet above finish floor.

- - E N D - - -

SECTION 22 11 00
FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Penetrations in rated enclosures: Section 07 84 00, FIRESTOPPING.
- B. Preparation and finish painting and identification of piping systems: Section 09 91 00, PAINTING.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Pipe Insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Piping.
 - 2. Strainers.
 - 3. 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. Federal Specifications (Fed. Spec.):
 - A-A-1427C.....Sodium Hypochlorite Solution
 - A-A-59617.....Unions, Brass or Bronze Threaded, Pipe
Connections and Solder-Joint Tube Connections
- C. American National Standards Institute (ANSI):
 - American Society of Mechanical Engineers (ASME): (Copyrighted Society)
 - A13.1-96.....Scheme for Identification of Piping Systems
 - B16.3-98.....Malleable Iron Threaded Fittings ANSI/ASME
 - B16.4-98.....Cast Iron Threaded Fittings Classes 125 and 250
ANSI/ASME
 - B16.9-01.....Factory-Made Wrought Steel Buttwelding Fittings
ANSI/ASME
 - B16.11-01.....Forged Steel Fittings, Socket-Welding and
Threaded ANSI/ASME

B16.12-98.....Cast Iron Threaded Drainage Fittings ANSI/ASME

B16.15-85(R 1994).....Cast Bronze Threaded Fittings ANSI/ASME

B16.18-01.....Cast Copper Alloy Solder-Joint Pressure
Fittings ANSI/ASME

B16.22-01.....Wrought Copper and Copper Alloy Solder Joint
Pressure Fittings ANSI/ASME
Element ANSI/ASME

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

A47-99.....Ferritic Malleable Iron Castings Revision 1989

A53-02.....Pipe, Steel, Black And Hot-Dipped, Zinc-coated
Welded and Seamless

A74-03.....Cast Iron Soil Pipe and Fittings

A183-83(R1998).....Carbon Steel Track Bolts and Nuts

A312-03.....Seamless and Welded Austenitic Stainless Steel
Pipe

A536-84(R1999) E1.....Ductile Iron Castings

A733-03.....Welded and Seamless Carbon Steel and Austenitic
Stainless Steel Pipe Nipples

B32-03.....Solder Metal

B61-02.....Steam or Bronze Castings

B62-02.....Composition Bronze or Ounce Metal Castings

B75-99(Rev A).....Seamless Copper Tube

B88-03.....Seamless Copper Water Tube

B584-00.....Copper Alloy Sand Castings for General
Applications Revision A

B687-99.....Brass, Copper, and Chromium-Plated Pipe Nipples

C564-03.....Rubber Gaskets for Cast Iron Soil Pipe and
Fittings

D2000-01.....Rubber Products in Automotive Applications

D4101-03b Propylene Plastic Injection and Extrusion
Materials

D2447-93.....Polyethylene (PE) Plastic Pipe, Schedule 40 and
80, Based on Outside Diameter

D2564-94.....Solvent Cements for Poly (Vinyl Chloride) (PVC)
Plastic Pipe and Fittings

D2665-94 Revision A.....Poly (Vinyl Chloride) (PVC) Plastic Drain,
Waste, and Vent Pipe and Fittings

- D4101-03b.....Propylene Plastic Injection and Extrusion
Materials
- E1120.....Standard Specification For Liquid Chlorine
- E1229.....Standard Specification For Calcium Hypochlorite
- E. American Water Works Association (AWWA):
 - C110-03/ A21.10-03.....Ductile Iron and Gray Iron Fittings - 75 mm
thru 1200 mm (3 inch thru 48 inches) for Water
and other liquids AWWA/ ANSI
 - C151-00/ A21.51-02.....Ductile-Iron Pipe, Centrifugally Cast in Metal
Molds or Sand-Lined Molds, for Water or Other
Liquids AWWA/ ANSI
 - C203-02.....Coal-Tar Protective Coatings and Linings for
Steel Water Pipelines - Enamel and Tape - Hot
Applied AWWA/ ANSI
 - C651-99.....Disinfecting Water Mains
- F. American Welding Society (AWS):
 - A5.8-92.....Filler Metals for Brazing
- G. National Association of Plumbing - Heating - Cooling Contractors
(PHCC):
 - National Standard Plumbing Code - 1996
- H. International Association of Plumbing and Mechanical Officials (IAPMO):
 - Uniform Plumbing Code - 2000
 - IS6-93.....Installation Standard
- I. Manufacturers Standardization Society of the Valve and Fittings
Industry, Inc. (MSS):
 - SP-72-99.....Ball Valves With Flanged or Butt Welding For
General Purpose
 - SP-110-96.....Ball Valve Threaded, Socket Welding, Solder
Joint, Grooved and Flared Ends
- J. American Society of Sanitary Engineers (ASSE):
 - 1001-02.....Pipe Applied Atmospheric Type Vacuum Breakers
 - 1018-01.....Performance for trap seal primer valve-water
supply fed
 - 1020-04.....Vacuum Breakers, Anti-Siphon, Pressure Type
- K. Plumbing and Drainage Institute (PDI):
 - PDI WH-201.....Water Hammer Arrestor

PART 2 - PRODUCTS

2.1 WATER SERVICE CONNECTIONS TO BUILDINGS

- A. From inside face of exterior wall to a distance of approximately 1500 mm (5 feet) outside of building and underground inside building, material selected shall be the same for the size specified.
- B. Seventy five millimeters (3 inch) Diameter and Over: Ductile iron, AWWA C151, 850 kPa (125 pounds) water steam pressure (WSP), exterior bituminous coating, cement lined. Provide flanged and anchored connection to interior piping.
- C. Under 75 mm (3 inch) Diameter: Copper tubing, ASTM B88, Type K, seamless, annealed. Fittings as specified under Article, INTERIOR DOMESTIC WATER PIPING. Use brazing alloys, AWS A5.8, Classification BCuP.

2.2 INTERIOR DOMESTIC WATER PIPING

- A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. For pipe 150 mm (6 inches) and larger, stainless, steel ASTM A312, schedule 10 may 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.
 - 2. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper ASTM B75 C12200, 125 to 150 mm (5 to 6 inch) 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. 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 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. Braze joints.
- C. Adapters: Provide adapters for joining screwed pipe to copper tubing.
- D. Solder: ASTM B32 Composition Sb5 HA or HB. Provide non-corrosive flux.
- E. 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, (125 and 250).

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

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

Unions 65 mm (2-1/2 inches) 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 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.

2.5 WATERPROOFING

A. Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth.

B. Floors: Provide cast iron stack sleeve with flashing device and a underdeck clamp. After stack is passed through sleeve, provide a waterproofed caulked joint at top hub.

C. Walls: See detail shown on drawings.

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 80 mm (3 inches), brass or bronze; 80 mm (3 inches) and larger, cast iron or semi-steel.

2.7 DIELECTRIC FITTINGS

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

2.8 STERILIZATION CHEMICALS

- A. Liquid Chlorine: ASTM E1120.
- B. Hypochlorite: ASTM E1229, or Fed. Spec. AA-1427C, grade B.

2.9 WATER HAMMER ARRESTER:

Closed copper tube chamber with permanently sealed 410 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N O-rings pressure packed and lubricated with FDA approved Dow Corning No. 11 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). Unit shall be as manufactured by Precision Plumbing Products Inc., Watts or Sioux Chief. Provide water hammer arrestors at all solenoid valves, at all groups of two or more flush valves, at all quick opening or closing valves, and at all medical washing equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with the PHCC National Standard 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 of the National Standard Plumbing Code, Chapter No. 8.
 - 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 unplated 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.
6. Install cast 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, FIRESTOPPING. 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, JOINT SEALANTS.
- B. Piping shall conform to the following:
1. Domestic Water:

- a. Where possible, grade all lines to facilitate drainage. Provide drain valves at bottom of risers. All unnecessary traps in circulating lines shall be avoided.
- 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.
- 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 690 kPa (100 psi) 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. Reagent Grade Water Systems: Fill system with water and maintain hydrostatic pressure of 690 kPa (100 psi) 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 either liquid chlorine or hypochlorite for sterilization.

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SECTION 22 13 00
FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 DESCRIPTION

Sanitary sewerage systems, including piping, equipment and all necessary accessories as designated in this section.

1.2 RELATED WORK

- A. Penetrations in rated enclosures: Section 07 84 00, FIRESTOPPING.
- B. Preparation and finish painting and identification of piping systems: Section 09 91 00, PAINTING.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Pipe Insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Piping.
 - 2. 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 National Standards Institute (ANSI):
 - American Society of Mechanical Engineers (ASME): (Copyrighted Society)
 - A112.1.1M-91.....Floor Drains ANSI/ASME
 - A13.1-96.....Scheme for Identification of Piping Systems
 - B16.3-98.....Malleable Iron Threaded Fittings ANSI/ASME
 - B16.4-98.....Cast Iron Threaded Fittings Classes 125 and 250
ANSI/ASME
 - B16.12-98.....Cast Iron Threaded Drainage Fittings ANSI/ASME
 - B16.15-85(R 1994).....Cast Bronze Threaded Fittings ANSI/ASME
Element ANSI/ASME

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

A47-99.....Ferritic Malleable Iron Castings Revision 1989
A53-02.....Pipe, Steel, Black And Hot-Dipped, Zinc-coated
 Welded and Seamless
A74-03.....Cast Iron Soil Pipe and Fittings
A183-83(R1998).....Carbon Steel Track Bolts and Nuts
A536-84(R1999) E1.....Ductile Iron Castings
B32-03.....Solder Metal
B75-99(Rev A).....Seamless Copper Tube
B306-02.....Copper Drainage Tube (DWV)
B584-00.....Copper Alloy Sand Castings for General
 Applications Revision A
C564-03.....Rubber Gaskets for Cast Iron Soil Pipe and
 Fittings
D2000-01.....Rubber Products in Automotive Applications
D2564-94.....Solvent Cements for Poly (Vinyl Chloride) (PVC)
 Plastic Pipe and Fittings
D2665-94 Revision A.....Poly (Vinyl Chloride) (PVC) Plastic Drain,
 Waste, and Vent Pipe and Fittings

D. National Association of Plumbing - Heating - Cooling Contractors
(PHCC):

National Standard Plumbing Code - 1996

E. Cast Iron Soil Pipe Institute (CISPI):

301-04.....Hubless Cast Iron Soil and Fittings

F. International Association of Plumbing and Mechanical Officials (IAPMO):

Uniform Plumbing Code - 2000

IS6-93.....Installation Standard

G. American Society of Sanitary Engineers (ASSE):

1018-01.....Performance for trap seal primer valve-water
 supply fed

H. Factory Mutual (FM):

a. Coupling Used in Hubless Cast Iron Systems for Drains, Waste and
 Vent Systems.

I. Plumbing and Drainage Institute (PDI):

PDI WH-201.....Water Hammer Arrestor

PART 2 - PRODUCTS

2.1 SANITARY PIPING

- A. Cast Iron Soil Pipe and Fittings: Used for pipe buried in or in contact with earth and for extension of pipe to a distance of approximately 1500 mm (5 feet) outside of building walls and interior waste and vent piping above grade. Pipe shall be bell and spigot, modified hub, or plain end (no-hub) as required by selected jointing method:
1. Material, (Pipe and Fittings): ASTM A74, C1SP1-301, Service Class.
 2. Joints: Provide any one of the following types to suit pipe furnished.
 - a. Lead and oakum and caulked by hand.
 - b. Double seal, compression-type molded neoprene gasket. Gaskets shall suit class of pipe being jointed.
 - c. Mechanical: Meet the requirements and criteria for pressure, leak, deflection and shear tests as outlined in Factory Mutual No. 1680 for Class 1 couplings.
 - 1) Stainless steel clamp type coupling of elastomeric sealing sleeve, ASTM C564 and a Series 300 stainless steel shield and clamp assembly. Sealing sleeve with center-stop to prevent contact between pipes/fittings being joined shall be marked ASTM C564.
 - 2) Cast Iron coupling with neoprene gasket and stainless steel bolts and nuts.
 - d. Mechanical Grooved Couplings: Shall consist of ductile iron (ASTM A536, Grade 65-45-12), or malleable iron (ASTM A47, Grade 32510) housings, a pressure responsive elastomeric gasket (ASTM D2000), and steel track head bolts. Shall be for use on pipe and fittings grooved to the manufacturer's specifications. Couplings and fittings to be of the same manufacturer.
 - e. Adapters: Where service weight pipe is connected to extra heavy pipe and extra heavy fittings of chair carriers, provide adapters or similar system to make tight, leakproof joints.
- B. Steel Pipe and Fittings: May be used for vent piping above grade.
1. Pipe Galvanized: ASTM A53, standard weight.
 2. Fittings:
 - a. Soil, Waste and Drain Piping: Cast iron, ANSI B16.12, threaded, galvanized.

- b. Sanitary and Exhaust Vent Piping: Malleable iron, ANSI B16.3, or cast iron, ANSI B16.4. All piping shall be of the same kind. Couplings of vent piping may be standard couplings furnished with pipe.
 - c. Unions: Tucker connection or equivalent type throughout.
 - d. Mechanical Grooved Couplings: Shall consist of ductile iron (ASTM A536, Grade 65-45-12), or malleable iron (ASTM A47, Grade 32510) housings, a pressure responsive elastomeric gasket (ASTM D2000), and steel track head bolts. Shall be for use on pipe and fittings grooved to the manufacturer's specifications. Couplings and fittings to be of the same manufacturer.
- C. Copper Tube, (DWV): May be used for piping above ground, except for urinal drains.
- 1. Tube: ASTM B306.
 - 2. Fittings:
 - a. Solder type.
 - b. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper conforming to ASTM B75 C12200, 125 to 150 mm (5 to 6 inch) bronze casting conforming to ASTM B584, CDA 844(81-3-7-9). Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12), or malleable iron, ASTM A47 (Grade 32510) housings, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
 - 3. Joints: ASTM B32, 50/50, special alloy, lead free. Solder using non-corrosive flux.
- D. ABS Pipe: ASTM D2751, SDR 23.5, 35, 42 Acrylonitrile-Butadiene-Styrene (ABS) materials, bell and spigot style solvent sealed ends.
- 1. Fittings: ABS, ASTM D2751.
 - 2. Joints: ASTM D2235, solvent weld.

2.2 EXPOSED WASTE PIPING

- A. Finished Room: Use full iron pipe size chrome plated brass piping 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. Pipe: Fed. Spec. WW-P-351, standard weight.
 - 2. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
 - 3. Nipples: ASTM B 687, Chromium-plated.

4. Unions: Brass or Bronze with chrome finish. Unions 65 mm (2-1/2 inches) 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.

2.3 CLEANOUTS

A. Same size as the pipe, up to 100 mm (4 inches); not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Provide a minimum clearance of 600 mm (24 inches) for the rodding.

B. In Floors: Floor cleanouts shall have cast iron body and frame with square adjustable scoriated secured nickel bronze top. Unit shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, provide clamping collars on the cleanouts. Cleanouts shall consist of "Y" fittings and 3 mm (1/8 inch) 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, provide carpet cleanout markers. Provide two way cleanouts where indicated on drawings.

C. Provide cleanouts 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. Extend the cleanouts to the wall access cover. Cleanout shall consist of sanitary tees. Furnish nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed roughing work, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required by the NPHCC National Standard Plumbing Code.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.4 FLOOR DRAINS

- A. ANSI A112.21.1. Provide a caulking flange for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe, and side outlet when shown. Provide membrane clamp and extensions 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, provide a 2.2 kg (16-ounce) soft copper membrane, 600 mm (24 inches) square.
- B. Type B: Galvanized cast iron with medium duty nickel bronze grate, double drainage pattern, clamping device, without sediment bucket but with secondary strainer in bottom. One hundred seventy five millimeters (seven inch) minimum square grate.
- C. Type C: Cast iron body, double drainage pattern, clamping device, light duty square or round nickel bronze adjustable strainer and grate with vandal proof screws. One hundred fifty millimeter (6 inch) minimum square grate.
- D. Type D: Cast iron drain 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 for synthetic covering.
- E. Type E: Heavy, cast iron body, double drainage pattern, heavy non-tilting // nickel bronze // ductile iron // grate not less than 300 mm (12 inches) square, removable sediment bucket. Clearance between body and bucket shall be ample for free flow of waste water. For traffic use ductile iron grate.
- F. Type F: Cast iron drain 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: Cast iron body, shallow type with double drainage flange with removable, perforated aluminum sediment bucket with all interior exposed surfaces provided with acid resistant porcelain enamel finish and clamping device. Frame and grate, shall be nickel bronze. Grate shall be approximately 200 mm (8 inches) in diameter. Space between body of drain and basket to be ample for free flow of waste water.

- H. Type H: Cast iron body, double drainage pattern, without sediment bucket but with loose set nickel bronze grate, secondary strainer, and integral clamping collar; 300 mm (12 inches) in diameter or 300 mm (12 inches) square and approximately 150 mm (6 inches) deep.
- I. Type I: Cast iron body, wide flange for seamless floor, double drainage pattern, with all interior exposed surfaces provided with acid resistant enamel finish, clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket, perforated with not less than 19 300 square mm (30 square inches) of free area, approximately 100 mm (4 inches) deep, and be provided with grips for easy handling; loose-set, nickel bronze grate approximately 300 mm (12 inches) square and of sufficient strength to support pedestrian traffic. Provide ample space between body of drain and sediment basket for free flow of waste liquids.
- J. Type M: 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.
- K. Type N: Cast iron body, wide flange for seamless floors, double drainage pattern, with all interior exposed surfaces provided with acid resistant enamel finish, 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, approximately 50 mm (2 inches) deep, and be provided with grips for easy handling; loose-set, nickel bronze grate approximately 200 mm (8 inches) round and of sufficient strength to support pedestrian traffic. Provide ample space between body of drain and sediment basket for free flow of waste liquids.
- L. Type O: Cast iron body, double drainage pattern, clamping device, less grate and sediment basket but with dome type secondary strainer. Three hundred millimeter 300 mm (12 inches) in diameter or 300 mm (12 inches) square and approximately 150 mm (6 inches) deep. Interior exposed surfaces and rim to have acid resisting, enamel finish.

- M. Type P: Cast iron body, double drainage pattern, with all interior exposed surfaces provided with acid resistant enamel finish, clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket, perforated with not less than 27 000 mm² (42 square inches) of free area, approximately 100 mm (4 inches) deep, and be provided with grips for easy handling; loose-set, nickel bronze grate approximately 300 mm² (12 inches square) and of sufficient strength to support pedestrian traffic. Provide ample space between body of drain and sediment basket for free flow of waste liquids.
- N. Type R: Cast iron body, double drainage pattern and clamping device, less grate and sediment basket but with dome type secondary strainer. Two hundred millimeter (8 inches) in diameter or 200 mm (8 inches) square and approximately 150 mm (6 inches) deep. Interior exposed surfaces and rim to have acid resisting finish.
- O. Type S: Sanitary Floor Sink: Type 304 stainless steel, 300 mm (12 inches) square, 200 mm (8 inches deep), polished interior, double drainage flange with weep holes, internal dome strainer, heavy duty non-tilting loose set grate. Provide clamping device.
- P. Open Sight Drains (OSD): Shall be cast iron, constructed as shown by detail.
- Q. Type X: Chemical resistant floor drain and "P" trap. Double drainage pattern with 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. Provide outlet of floor drain suitable for properly joining a perforated or slotted floor level grate.
- R. Type Y: For parking decks Heavy: galvanized cast iron body with double drainage pattern, heavy duty polished bronze grate not less than 225 mm (9 inches) in diameter, seepage pan and combination membrane flashing clamp, heavy duty support flange, under deck clamp and vandal proof grate.

2.5 TRAPS

Provide 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 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.

2.6 TRAP PRIMERS

A. Trap Primer (TP-2): Hydraulic.

1. Fifteen millimeter (1/2 inch) Inlet/ fifteen millimeter (1/2 inch) Outlet fully automatic, all brass trap primer valve, activated by a drop in building water pressure, no adjustment required. Model for one (1) to four (4) traps with distribution unit, may be located anywhere in an active cold water line, as indicated on the drawings or as required by code. ASSE Standard 1018. Omit distribution unit when serving a single trap.

2.7 WATERPROOFING

- A. Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth.
- B. Floors: Provide cast iron stack sleeve with flashing device and a underdeck clamp. After stack is passed through sleeve, provide a waterproofed caulked joint at top hub.
- C. Walls: See detail shown on drawings.

2.8 DIELECTRIC FITTINGS

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with the PHCC National Standard Plumbing Code and the following:
 1. Install branch piping 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.
 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 valves with stem in horizontal position whenever possible. All valves shall be easily accessible. Install valve in each water connection to fixture.

5. All gravity waste drain lines inside the building with vertical drops over 6 m (20 feet) shall be provided with joint restraint on the vertical drop and horizontal offset or branch below the vertical drop. Joint restraint shall be accomplished by threaded, soldered, lead and oakum or grooved joints or a combination of pipe clamps and tie-rods as detailed in NFPA 24. Vertical joint restraint shall be provided from the fitting at the bottom of the vertical drop through every joint up to the riser clamp at the floor penetration of the floor above. Horizontal joint restraint shall be provided from the same fitting at the bottom of the vertical drop through every joint on the horizontal offset or branch for a minimum of 18 m (60 feet) or to anchoring point from the building structure. Joint restraint below ground shall be accomplished by thrust blocks detailed in NFPA 24.
6. Pipe Hangers, Supports and Accessories:
 - a. All piping shall be supported per of the National Standard Plumbing Code, Chapter No. 8.
 - 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 unplated 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.
7. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
8. 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, FIRESTOPPING. 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, JOINT SEALANTS.
- B. Piping shall conform to the following:
 1. Waste and Vent Drain to main stacks:

Pipe Size	Minimum Pitch
80 mm (3 inches) and smaller	1 : 50 (1/4" to the foot).
80 mm (4 inches) and larger	1 : 100 (1/8" to the foot).

2. Exhaust Vent: Extend separately through roof. Sanitary vents shall not connect to exhaust vents.

3.2 TESTS

- A. General: Test system either in its entirety or in sections.
- B. Waste Systems: Conduct before trenches are backfilled or fixtures are connected. Conduct water test or air test, as directed.
 1. Water Test: If entire system is tested, tightly close all openings in pipes except highest opening, and fill system with water to point

- of overflow. If system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Keep water in system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
2. Air Test: Maintain air pressure of 35 kPa (5 psi) gage for at least 15 minutes without leakage. Use force pump and mercury column gage.
 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 (one inch of water) with a smoke machine. Chemical smoke is prohibited.
 - b. Peppermint Test: Introduce (two ounces) of peppermint into each line or stack.

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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.

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-04.....Enameled Cast Iron Plumbing fixtures
A112.19.2M-03(R2008)....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):
A276-2003.....Stainless and Heat-Resisting Steel Bars and
Shapes
- 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):

61-03.....Drinking Water System Components-Health Effects

G. American with Disabilities Act(A.D.A) Section 4-19.4 Exposed Pipes and
Surfaces

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.

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 to 110 mL/s (1.5 to 1.7 gpm) for lavatories; 125 to 140 mL/s (2.0 to 2.2 gpm) for sinks P-505 through P-520, P-524 and P-528; and 170 to 190 mL/s (2.75 to 3.0 gpm) for dietary food preparation and rinse sinks.
2. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 170 and 550 kPa (25 and 80 psi).
3. Operates by expansion and contraction, eliminates mineral/sediment build-up with self-clearing action, and is capable of easy manual cleaning.

C. Device manufactured by OMNI Products, Inc. or equal.

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, 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

- A. Provide and install plumbing fixtures complete and operational as indicated and specified on drawings.

PART 3 - EXECUTION

- 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 75 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 35 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.

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**SECTION 22 62 00
VACUUM SYSTEMS FOR HEALTHCARE FACILITIES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Healthcare Vacuum Systems: This section describes the labor, equipment, and services necessary for and incidental to the installation of piped medical vacuum systems. Medical vacuum shall be installed, tested, and ready for use. The scope of work shall include all necessary piping, fittings, valves, cabinets, station outlets and inlets, rough ins, gages, alarms including low voltage wiring, and connections.
- B. The contractor shall provide all elements and accessories required for a complete system according to the most recent edition of NFPA 99C, Gas and Vacuum Systems.
- C. Electrical power for alarms wiring to alarm panels.
- D. Pressure testing, cross connection testing and final testing per NFPA 99 most recent edition and using procedures shall be performed.
- E. The contractor shall retain a qualified third party medical vacuum verifier acceptable to the engineer and VA to perform and attest to final verification of the systems.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Sealing around pipe penetrations to maintain the integrity of time rated construction.
- B. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General requirements and items common to more than one section of Division 22.
- C. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Alarm interface with ECC.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.
- E. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Control wiring.

F. Section 26 27 26, WIRING DEVICES: Electrical wiring and accessories.

G. Section 22 63 00, GAS SYSTEMS FOR HEALTHCARE FACILITIES: Healthcare Gases and Vacuum Alarms.

1.3 QUALITY ASSURANCE

A. Contractor shall include with submittals an affidavit attesting to compliance with all relevant paragraphs of NFPA 99 most recent edition. Personnel assembling medical vacuum and WAGD system shall meet NFPA 99 5.1.10.10.11 "Qualification of Installers" and hold medical gas endorsements as under ASSE 6010. The Contractor shall furnish documentation attesting that all installed piping materials were purchased cleaned and complied with the requirements of NFPA 99 5.1.10.1 and 5.1.10.2. Electrical Control systems and Medical vacuum Alarms are to be UL listed as assemblies with label affixed.

B. Equipment Installer: The equipment installer shall show documentation proving that the personnel installing the equipment meet the standards set by the American Society of Sanitary Engineers (ASSE) 6010 Professional Qualification Standards for Medical Gas System Installers. Show technical qualifications and previous experience in installing medical gas equipment on three similar projects. Submit names and addresses of referenced projects. The equipment install shall perform the following coordination functions:

1. Coordinate with other trades to ensure timely installations and avoid conflicts and interferences.
2. Work with the metal stud partition installer and/or mason to ensure anchors, sleeves and similar items are provided in sufficient time to avoid delays.
3. Coordinate with VA to ensure medical vacuum inlets in walls is provided by the same Medical Vacuum Equipment Manufacturer satisfactory to the owner.
4. The contractor shall coordinate with the Medical Vacuum System

Verifier to deliver a complete, tested medical gas installation ready for owner's use.

- C. Equipment Supplier: The Equipment supplier shall demonstrate evidence of installing equivalent product at three installations similar to this project that has been in satisfactory and efficient operation for three years. Names and addresses where the product is installed shall be submitted for verification.
- D. Medical Gas System Testing Organization: The Medical vacuum verifier shall show documentation proving that the medical gas verifier meet the standards set by the American Society of Sanitary Engineers (ASSE) 6010 Professional Qualification Standards for Medical Gas Ssystem Verifiers. The testing shall be conducted by a party technically competent and experienced in the field of medical gas pipeline testing. Such testing shall be performed by a party other than the installing contractor.
- E. Names of three projects where testing of vacuum systems has been performed by the testing agency shall be provided. The name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification shall be included in the documentation.
- F. The testing agency's detailed procedure which will be followed in the testing of this project shall be submitted. In the testing agency's procedure documentation, include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, data on test methods, types of equipment to be used, calibration sources and method references shall be submitted.
- G. Certification: The Final inspection documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this specification.

H. The installing contractor shall maintain as-built drawings of each completed phases for verification; and, shall provide the complete set at the time of final systems certification testing, for certification by the Third Party Testing Company. As-built drawings shall be provided, and a copy of them on Auto-Cad version (R-14 or later) provided on compact disk.

1.4 SUBMITTALS

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

B. Manufacturer's Literature and Data:

1. Complete specifications for the product intended to be installed, dimensional drawings, and wiring schematics.

2. Piping.

3. Valves.

4. Valve cabinets.

5. Gages.

6. Station inlets, and rough in assemblies.

7. Alarm controls and panels.

8. Vacuum switches.

9. Vacuum bottle brackets.

C. Station Inlets: A letter from manufacturer shall be submitted stating that inlets are designed and manufactured to comply with NFPA 99. Inlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation.

D. Certification: The completed systems have been installed, tested, purged and analyzed in accordance with the requirements of this specification.

E. A notarized affidavit from the verifier stating that the verifier undertakes to verify this project and thus agrees to disqualify themselves from supplying any equipment which will be included in the scope of their verification. No verifier who supplies equipment shall be permitted to verify that equipment. Statement declaring that the vacuum system manufacturer has no fiduciary interest in the verifier and that the verifier is not an agent or representative of the vacuum system manufacturer. Statement declaring that the contractor has no fiduciary interest in the third party verifier and that the third party verifier has no fiduciary interest in the contractor.

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 test by the basic designation only.

B. American National Standards Institute (ANSI):

A13.1-2007.....Scheme for Identification of Piping Systems

B16.22-01 (R2005).....Wrought Copper and Bronze Solder-Joint Pressure Fittings

B40.1-(2006)..... Pressure Gauges and Gauge Attachments

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

B819-00.....Standard Specification for Seamless Copper Tube for Medical Gas Systems

D. American Society of Mechanical Engineers (ASME):

Section IX-04.....Welding and Brazing Qualifications

E. American Welding Society (AWS):

AWS A5.8/A5.8M-2004.....Brazing Filler Metal

AWS B2.2-91.....Standard for Brazing Procedure and Performance Qualification (Modified per NFPA 99)

F. Compressed Gas Association (CGA):

P-9-92.....Inert Gases Argon, Nitrogen and Helium

G. National Electrical Manufacturers Association (NEMA):

ICS-6-(1993, R 2006)....Industrial Controls and Systems Enclosures

H. National Fire Protection Association (NFPA):

70(2007).....National Electric Code

99-2005.....Health Care Facilities with 2005 errata

I. United States Pharmacopoeia XXI/National Formulary XVI (USP/NF)

J. Manufacturing Standardization Society (MSS):

MSS-SP-72-99.....Ball Valves With Flanged or Butt Welding For
General PurposeMSS-SP-110-96.....Ball Valve Threaded, Socket Welding, Solder
Joint, Grooved and Flared EndsMSS-SP-73-03.....Brazing Joints for Copper and Copper Alloy
Solder Pressure Fittings**PART 2 - PRODUCTS****2.1 GENERAL PRODUCT REQUIREMENTS**

- A. One Medical Vacuum Equipment Manufacturer shall supply the medical vacuum system(s) and equipment to include outlets, valves and gauges, valve boxes and alarm panels.

2.2 PIPING

- A. Copper Tubing: Copper tubing shall be type "K" or "L", ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ANSI B16.22 or brazing fittings complying with MSS SP-73. The copper tubing size designated reflects nominal inside diameter. All tubing and fittings shall be labeled "ACR/OXY", "OXY", "OXY/MED", "ACR/MED", or "MED".

- B. Brazing Alloy: The brazing alloy shall comply with AWS A5.8, Classification BCuP, greater than 537 °C (1000 °F) melting temperature. Flux shall be strictly prohibited for copper to copper connections.
- C. Screw Joints: Screw joints shall use polytetrafluoroethylene (teflon) tape.
- D. Piping identification labels shall be applied at time of installation in accordance with current NFPA. Supplementary color identification shall be in accordance with CGA Pamphlet C-9.

2.3 VALVES

- A. Ball: Ball valves shall be in line, other than zone valves in cabinets.

- 1. Sixty five millimeter or DN65 (2 1/2 inches) and smaller: Ball valves shall be bronze/ brass body, Fed. Spec. MSS SP72 & SP 110 , Type II, Class 150, Style 1, with tubing extensions for brazed connections, full ported, three piece or double union end connections, teflon seat seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle.

- B. Check:

- 1. Check valves eighty millimeters (DN80) (3 inches) and smaller: brass and Bronze body, straight through design for minimum pressure drop, spring loaded, self aligning with teflon cone seat, vibration free, silent operation, supplied NPT female threads at each end with flow direction arrow permanently cast into, 2750 kPa (400 psi) WOG minimum working pressure.

- C. Zone valve in cabinet shall be ball valve with bronze/ brass body, double seal, three piece or double union end connections, replaceable teflon seat seals, teflon stem seal, 4125 kPa (600 psi) WOG, cold, non shock gas working pressure or vacuum service to 29 inch Hg, blowout proof stem, one quarter turn of handle to completely open or close. Tubing extensions, factory brazed, pressure tested, cleaned for oxygen service shall be provided. A 3 mm (1/8 inch) NPT gauge port shall be provided for a 50mm (2 inch) diameter monitoring gauge downstream of the shut off valve. Zone valves shall be securely attached to the

cabinet and provided with type-K copper tube extensions for making connection to system piping outside the cabinet. Zone valves shall be products of one manufacturer, and uniform throughout in pattern, overall size and appearance. Trim with color coded plastic inserts or color coded stick on labels. Valves shall be in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
MEDICAL VACUUM	Black letters on white background	WHITE

2.4 VALVE CABINETS

- A. Valve cabinets shall be flush mounted, commercially available item for use with medical gas services, constructed from steel not lighter than 1.3 mm (18 gage) steel or extruded aluminum not lighter than 1.9 mm (14 gage). The valve cabinets shall be rigidly assembled, of adequate size to accommodate all valve(s) and fittings indicated. Holes shall be predrilled to receive pipe connections. These pipe connections shall be made outside of the valve box. Anchors shall be provided to secure cabinet to wall construction. Openings in cabinet shall be sealed to be dust tight. Bottom of cabinet shall be located 1375 mm (4 foot 6 inches) above finished floor.
- B. Engraved rigid plastic identification plate shall be mounted on the wall above or adjacent to the cabinet. Color code identification plate to match gas identification colors as indicated above. Identification plate shall be clearly visible at all times. Inscriptions shall be provided on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS." The final wording must be approved by the VA project manager.
- C. Cover plate: The cover plate shall be fabricated from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or

.85 mm (22 gage) stainless steel. A cover window shall be provided of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. The following shall be permanently painted or stenciled on window: "FOR EMERGENCY SHUT-OFF VALVES ONLY, SHUT OFF VALVES FOR PIPED GASES", or equivalent wording. The valve cabinet shall be configured such that it is not possible to install window with any valve in the closed position. Each valve shall have a pressure gauge upstream of valve and this pressure gauge shall be inside valve box.

2.5 GAGES

A. Vacuum Gages:

1. For vacuum service upstream of main shutoff valve: A 40 mm (1-1/2 inch) diameter gage shall be provided with steel case, bourdon tube and brass movement, dial range 0 to -100 kPa (0-30 inches Hg). Compound gages shall be provided for Vacuum system.

2.6 STATION INLETS

A. Vacuum Station inlets:

1. Station inlets shall be for designated service, consisting of a quick coupler, quick disconnect type with inlet supply tube.
2. The outlet station shall be made, cleaned, and packaged to NFPA 99 standards and shall be UL listed and CSA certified.
3. A coupler shall be provided that is non-interchangeable with other services, and leak proof under three times normal working pressure.
4. Each station inlet shall be equipped with an automatic valve to conform with NFPA 99. Valves shall be placed in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing.
5. Each inlet shall be securely fastened to rough-in to prevent floating and provide each with a capped stub length of 6 mm (1/4-inch) (10 mm outside diameter) (3/8-inch outside diameter) tubing for connection to supply tubing. Stub tubing shall be labeled for

appropriate service. Rough in shall be indexed and gas specified latch vale with non-interchangeable safety keying with color coded gas service identification.

6. Completion kits (valve body and face plate) shall be installed for the remainder of required tests.

2.7 STATION INLET ROUGH-IN

- A. Station inlet rough in shall be Flush mounted, and protected against corrosion. Rough in shall be anchored securely to unit or wall construction.
- B. The modular cover plate shall be constructed from die cast plate, two piece .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, secured to rough in with stainless steel or chromium plated countersunk screws. The latch mechanism shall be designed for one handed, singe thrust mounting and one handed fingertip release of secondary equipment.
- C. Permanent, metal or plastic, identification plates shall be provided securely fastened at each inlet opening, with inscription for appropriate service using color coded letters and background. Metal plates shall have letters embossed on baked on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
MEDICAL VACUUM	Black letters on white background

2.8 VACUUM SWITCHES

- A. Vacuum switches shall be general purpose, contact or mercury type, allowing both high and low set points, with contact type provided with a protective dust cover. The vacuum switch shall have an adjustable range set by inside or outside adjustment. Vacuum switches shall activate when indicated by alarm requirements. One orifice nipple (or DISS demand check valve) shall be used for each sensor switch.

2.9 VACUUM BOTTLE BRACKET

- A. Vacuum bottle bracket shall be single plate of one piece, .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal or aluminum, finish matching cover of adjoining vacuum inlet. All components shall be of same material as plate and assembly anchored securely. The bracket shall be provided and plastic vacuum bottle holder for each vacuum wall inlet.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. All installation shall be performed in strict accordance with NFPA 99 5.1.10. Brazing procedures shall be as detailed in NFPA 99 5.1.10.5. Brazing shall be performed only by brazers qualified under NFPA 99 5.1.10.10.11.
- B. Open ends of tube shall be capped or plugged at all times or otherwise sealed until final assembly.
- C. Piping shall be cut square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. the tubing shall be reamed to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. The tubing shall be worked into place without springing or forcing. The tubing shall be bottomed in socket so there are no gaps between tube and fitting. Care shall be exercised in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease from being introduced into the tubing. Where contamination has occurred, material shall be no longer suitable for vacuum service and new, sealed tube sections used..
- D. Piping shall be supported with pipe hangers at intervals as shown on the drawings or as defined in NFPA 99 Table 5.1.10.10.4.5. Piping shall not be supported by other piping. Isolation of copper piping from dissimilar metals shall be of a firm, positive nature. Duct tape is not acceptable as an isolation material..
- E. Valves shall be rigidly supported to prevent strain on tube or joints.

- F. During any brazing operation, the interior of the pipe shall be purged continuously with oil free, dry nitrogen NF, following the procedure in NFPA 99 5.1.10.5.5. At the completion of any section, all open pipe ends shall be capped using an EXTERNAL cap. The flow of purged gas shall be maintained until joint is cool to touch. The use of flux is prohibited when making of joints between copper to copper pipes and fittings.
- G. Threaded joints in piping systems shall be avoided whenever possible. Where unavoidable, make up the male threads with polytetrafluorofethylene (such as Teflon) tape. Liquid sealants shall not be used.
- H. Tubing shall not be bent. Fittings shall be used in all change of direction or angle.
- I. After installation of the piping, but before installation of the outlet valves, blow lines clear using nitrogen NF.
- J. Pressure and vacuum switches, transmitter and gauges shall be installed to be easily accessed. Pressure switch and sensors shall be installed with orifice nipple between the pipe line and switches/sensors.
- K. Pipe labeling shall be applied during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.
- L. After initial leakage testing is completed, the piping shall be allowed to remain pressurized with testing gas until testing agency performs final tests.
- M. A vacuum gage 40mm (1 1/2 inch) diameter line shall be installed downstream of each zone valve in cabinets.
- N. Zone valves shall be provided in cabinets where indicated and outside each Operating Room and a minimum one zone valve assembly for each 18 outlets.
- O. Piping shall be labeled with name of service, identification color and direction of flow. Where non-standard pressures are piped, pressure

shall be labeled. Labels shall be placed at least once every 20 feet of linear run or once in each story (whichever is more frequent). Pipe labels shall be self adhesive vinyl type or other water resistant material with permanent adhesive colored in accordance with NFPA 99 Table 5.1.11 and shall be visible on all sides of the pipe. Each master alarm signal shall be labeled for function after ring out. Each zone valve shall be labeled and each area alarm labeled for the area of control or surveillance after test. Labels shall be permanent and of a type approved by the VAMC

- P. Alarms and valves shall be labeled for service and areas monitored or controlled. Coordinate with the VAMC for final room or area designations. Valves shall be labeled with name and identification color of the gas and direction of flow

3.2 INSTALLER TESTING

- A. Prior to declaring the lines ready for final verification, the installing contractor shall strictly follow the procedures for verification as described in NFPA 99 5.1.12.2 and attest in writing over the notarized signature of an officer of the installing company the following;
1. That all brazing was conducted by brazers qualified to ASSE 6010 and holding current medical gas endorsements.
 2. That all brazing was conducted with nitrogen purging. (Procedure per NFPA 99 5.1.10.5.5).
 3. That the lines have been blown clear of any construction debris using oil free dry nitrogen or air are clean and ready for use. (Procedure per NFPA 99 5.1.12.2.2).
 4. That the assembled piping, prior to the installation of any devices, maintained a test pressure 1 1/2 times the standard pressures listed in NFPA 99 Table 5.1.11 without leaks. (Procedure per NFPA 99 5.1.12.2.3).

5. That after installation of all devices, the pipeline was proven leak free for 24hours at a pressure 20% above the standard pressures listed in NFPA 99 Table 5.1.11. (Procedure per NFPA 99 5.1.12.2.2.6)

6. That the systems have been checked for cross connections and none were found. (Procedure per NFPA 99 5.1.12.2.4)

B. Four originals of the affidavit, shall be distributed; (1) to the engineer, (1) to the owners representative, (1) to the general contractor and (1) to the verifier.

3.3 VERIFIER TESTING

A. Prior to handing over the systems to VAMC, the contractor shall retain a Verifier acceptable to the engineer and owner who shall follow strictly the procedures for verification as described in NFPA 99 5.1.12.3 and provide a written report and certificate bearing the notarized signature of an officer of the verification company which contains at least the following:

1. A current ACORD insurance certificate indicating professional liability coverage in the minimum amount of \$1 Million per occurrence, and general aggregate liability in the minimum amount of \$1 Million, valid and in force when the project is to be verified. General liability insurance is not alone acceptable.
2. An affidavit bearing the notarized signature of an officer of the verification company stating that the verification company is not the supplier of any equipment used on this project or tested in this report and that the verification contractor has no relationship to, or pecuniary interest in, the manufacturer, seller, or installer of any equipment used on this project or tested in this report
3. A listing of all tests performed, listing each source, outlet, valve and alarm included in the testing.
4. An assertion that all tests were performed by a Medical Vacuum System Certified Medical Gas or vacuum Verifier or by individuals qualified to perform the work and holding valid qualifications to ASSE 6030 and under the immediate supervision a Verifier. Include

the names, credential numbers and expiration dates for all individuals working on the project.

5. A statement that equipment used was calibrated at least within the last six months by a method traceable to a National Bureau of Standard Reference and enclosing certificates or other evidence of such calibration(s). Where outside laboratories are used in lieu of on site equipment, those laboratories shall be named and their original reports enclosed.
6. A statement that where and when needed, equipment was re calibrated during the verification process and describing the method(s) used.
7. A statement that the systems were tested and found to be free of debris to a procedure per NFPA 99 5.1.12.3.7.
8. The flow from each outlet when tested to a procedure per NFPA 99-5.1.12.3.10.
9. A statement that the systems were tested and found to have no cross-connections to a procedure per NFPA 99 5.1.12.3.3.
10. A statement that the systems were tested and found to be free of contaminants to a procedure per NFPA 99 5.1.12.3.8 except that the purity standard shall be 2 ppm difference for halogenated hydrocarbons and 1 ppm total hydrocarbons (as methane).
11. Statement that all local signals function as required under NFPA 99 5.1.3.4.7 and as per the relevant NFPA 99 sections relating to the sources.
12. A listing of area alarms, their function and activation pressures per NFPA 99 5.1.12.3.5.3.
13. The concentration of each gas at each outlet as specified in NFPA 99 5.1.12.3.11.
14. A statement that all valves and alarms are accurately labeled as to zone of control.

15. Provide four originals of this affidavit, and report, distributed;
(1) to the engineer, (1) to the owner's representative, (1) to the general contractor and (1) to the installing contractor.
- B. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with, current NFPA and the procedures set forth in pre-qualification documentation.
- C. Verify that the systems, as installed, meet or exceed the requirements of current NFPA, this specification, and that the systems operate as required.
- D. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 35 cubic feet (1000 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 Lpm). Filter shall show no discoloration, and shall accrue no more than 0.1 mg of matter. Test each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.
- E. Inlet flow test:
 1. Test all inlets for flow. Perform test with the use of an inert gas as described in CGA P-9.
 3. Vacuum inlets must draw no less than 85 Lpm (3.0 scfm) with adjacent inlet flowing, at a dynamic inlet pressure of 40 kPa (12-inches Hg), and a static vacuum of 50 kPa (15-inches Hg).

3.4 CONNECTION TO EXISTING VACUUM SYSTEM:

- A. Contactor shall test the existing system for hydrocarbons, etc. If problems are present, the resident engineer (RE) would notify the facility of the results. The facility would then make the necessary repairs and/ or maintenance.
- B. Shut-off valves shall be installed at the connection of new line to existing line.

- C. Time for shut-down of the existing vacuum system shall be coordinated with the VA medical center.
- D. Prior to any work being done, new pipeline shall be checked for particulate or other forms of contamination.
- E. Insure that the correct type of pipe tubing and fittings are being used.
- F. A spot check of the existing pipelines shall be made in the facility to determine the level of cleanness present.
- G. The tie-in shall be made as quickly as possible. A nitrogen purge is not required since this would require another opening in the pipe.
- H. After the tie-in is made and allowed to cool, slowly bleed the source Vacuum back into the pipeline. Test the work area for leaks with soapy water and repair any leaks.
- I. After all leaks, if any, are repaired and the line is fully recharged, perform blow down and testing. Open the zone that is closest to the main to the system, access the closest outlet to the work, and blow the main through the inlet. After the inlet blows clear into a white cloth, make an additional check at a zone most distant from the work. Perform all required current NFPA tests after connection.

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**SECTION 22 63 00
GAS SYSTEMS FOR HEALTHCARE FACILITIES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Healthcare Gas Systems: Consisting of oxygen, and medical air services; complete, ready for operation, including all necessary piping, fittings, valves, cabinets, station outlets, rough-ins, gages, alarms including low voltage wiring, and connections.
- B. Healthcare gas system alarm wiring to alarm panels.

1.2 RELATED WORK

- A. Sealing around pipe penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- B. General requirements and items common to more than one section of Division 22. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- C. Alarm interface with ECC. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- D. Conduit: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- E. Control wiring: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- F. Electrical wiring and accessories: Section 26 27 26, WIRING DEVICES.
- G. Vacuum Piping and Equipment: SECTION 22 62 00, VACUUM SYSTEMS FOR HEALTHCARE FACILITIES

1.3 QUALITY ASSURANCE

- A. Materials and Installation: In accordance with NFPA 99, (2005) and as specified.
- B. Equipment Installer: Show technical qualifications and previous experience in installing healthcare equipment on three similar projects. Submit names and addresses of referenced projects. Installers shall meet the qualifications of ANSI/ASSE Standard 6010.

- C. Equipment Supplier: Show evidence of equivalent product installed at three installations similar to this project that has been in satisfactory and efficient operation for three years. Submit names and addresses where the product is installed.
- D. Healthcare System Testing Organization: The testing shall be conducted by a party technically competent and experienced in the field of laboratory and healthcare pipeline testing. Testing and systems verification shall be performed by personnel meeting the qualifications of ANSI/ASSE Standard 6030. Such testing shall be performed by a party other than the installing contractor.
- E. Provide names of three projects where testing of medical gases systems has been performed by the testing agency. Include the name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification.
- F. Submit the testing agency's detailed procedure which will be followed in the testing of this project. Include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, include data on test methods, types of equipment to be used, calibration sources and method references.
- G. Certification: Provide documentation prior to submitting request for final inspection to include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this specification.
- H. Installing contractor shall maintain as-built drawings of each completed phases for verification; and, shall provide the complete set at the time of final systems certification testing, for certification by the Third Party Testing Company. As-built drawings shall be provided on prints and in digital format. The digital format shall be in the native CAD system required for the project design. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

- I. "Hot taps" are not permitted for operating medical oxygen systems. Methods for connection and extension of active and pressurized medical gas systems without subsequent medical gas testing and verification are not allowed.

1.4 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
1. Piping.
 2. Valves.
 3. Valve cabinets.
 4. Gages.
 5. Station outlets and rough-in assemblies.
 6. Alarm controls and panels.
 7. Pressure Switches.
- C. Station Outlets: Submit letter from manufacturer stating that outlets are designed and manufactured to comply with NFPA 99. Outlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation.
- D. Certification: The completed systems have been installed, tested, purged, analyzed and verified in accordance with the requirements of this specification.

1.5 TRAINING

- A. 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 laboratory and healthcare gas systems, on the dates requested by COTR.
- B. Coordinate with other requirements specified in Section 01 00 00, GENERAL REQUIREMENTS.

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 test by the basic designation only.

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

B819-(R2006).....Seamless Copper Tube for Medical Gas Systems

C. American Society of Mechanical Engineers (ASME):

A13.1-07.....Scheme for Identification of Piping Systems

B16.22-01(R2005).....Wrought Copper and Bronze Solder-Joint Pressure Fittings

B40.100 (2005)Pressure Gauges and Gauge Attachments Boiler and Pressure Vessel Code -

Section VIII-07.....Pressure Vessels, Division I

Section IX-07.....Welding and Brazing Qualifications

D. American Welding Society (AWS):

AWS A5.8-04.....Brazing Filler Metal

AWS B2.2-91.....Standard for Brazing Procedure and Performance Qualification (Modified per NFPA 99)

E. Compressed Gas Association (CGA):

C-9-04.....Standard Color Marking of Compressed Gas Cylinders

G-4.1 (2009).....Cleaning Equipment for Oxygen Service

G-10.1(2008)Nitrogen, Commodity

P-9-01.....Inert Gases Argon, Nitrogen and Helium

V-1-05.....Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections

F. National Electrical Manufacturers Association (NEMA):

ICS-6-93(R2006).....Industrial Controls and Systems Enclosures

G. National Fire Protection Association (NFPA):

99-05.....Health Care Facilities

H. United States Pharmacopoeia XXI/National Formulary XVI (USP/NF)

I. Manufacturing Standardization Society (MSS):

MSS-SP-72-99.....Ball Valves With Flanged or Butt Welding For
General Purpose

MSS-SP-110-96.....Ball Valve Threaded, Socket Welding, Solder
Joint, Grooved and Flared Ends

MSS-SP-73-03.....Braze Joints for Copper and Copper Alloy
Solder Pressure Fittings

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Copper Tubing: Type "K", ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ASME B16.22 or brazing fittings complying with MSS SP-73. Size designated reflecting nominal inside diameter. All tubing and fittings shall be labeled "ACR/OXY", "OXY", "OXY/MED", "ACR/MED", or "MED".
- B. Brazing Alloy: AWS A5.8, Classification BCuP, greater than 537 °C (1000 °F) melting temperature. Flux is strictly prohibited for copper-to-copper connections.
- C. Screw Joints: Polytetrafluoroethylene (teflon) tape.
- D. Apply piping identification labels at the time of installation in accordance with current NFPA. Apply supplementary color identification in accordance with CGA Pamphlet C-9.

2.2 VALVES

- A. Ball: In-line, other than zone valves in cabinets:
 - 1. Seventy five millimeter (2 1/2 inches) and smaller: Bronze/ brass body, Fed. Spec. MSS SP72 & SP 110 , Type II, Class 150, Style 1,

with tubing extensions for brazed connections, full port, three-piece or double union end connections, teflon seat seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle, cleaned for oxygen use and labeled for intended service

B. Check:

1. Eighty millimeter (3 inches) and smaller: Bronze/brass body, straight through design for minimum pressure drop, spring loaded, self aligning with teflon cone seat, vibration free, silent operation, supplied NPT female threads at each end with flow direction arrow permanently cast into, cleaned for oxygen use and labeled for intended service, 2750 kPa (400 psi) WOG minimum working pressure.

- C. Zone Valve in Cabinet: Ball valve, bronze/ brass body, double seal, three piece or double union end connections, replaceable teflon seat seals, teflon stem seal, 4125 kPa (600 psi) WOG, cold, non-shock gas working pressure service to 100 kPa (29 inch Hg), cleaned for oxygen use and labeled for intended service, blowout proof stem, one quarter turn of handle to completely open or close. Provide tubing extensions factory brazed, and pressure tested. Provide 3 mm (1/8 inch) NPT gauge port for a 50mm (2 inch) diameter monitoring gauge downstream of the shut off valve. Zone valves shall be securely attached to the cabinet and provided with type-K copper tube extensions for making connection to system piping outside the cabinet. Zone valves shall be products of one manufacturer, and uniform throughout in pattern, overall size and appearance. Trim with color coded plastic inserts or color coded stick-on labels. Install valves in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
OXYGEN	White letters on green background	GREEN
MEDICAL AIR	Black or white letters on yellow background	YELLOW

2.3 VALVE CABINETS

- A. Flush mounted commercially available item for use with laboratory and healthcare services, not lighter than 1.3 mm (18 gage) steel or 1.9 mm (14 gage) extruded aluminum, rigidly assembled, of adequate size to accommodate valve(s) and fittings. Punch or drill sides to receive tubing. Provide anchors to secure cabinet to wall construction. Seal openings in cabinet to be dust tight. Locate bottom of cabinet 1375 mm (4 foot 6 inches) above floor.
- B. Mount engraved rigid plastic identification plate on wall above or adjacent to cabinet. Color code identification plate to match gas identification colors as indicated above. Identification plate must be clearly visible at all times. Provide inscriptions on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS."
- C. Cover plate: Fabricate from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or .85 mm (22 gage) stainless steel. Provide cover window of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. Permanently paint or stencil on window: CAUTION-CLOSE ONLY IN EMERGENCY, SHUT-OFF VALVES FOR PIPED GASES", or equivalent wording. Configure such that it is not possible to install window with any valve in the closed position. Each valve shall have gauge upstream of valve inside valve box.

2.4 GAGES

- A. Pressure Gages: Includes gages temporarily supplied for testing purposes.
 - 1. For line pressure use adjacent to source equipment: ASME B40.1, pressure gage, single, size 115 mm (4-1/2 inches), for medical air and oxygen, accurate to within two percent, with metal case. Range shall be two times operating pressure. Dial graduations and figures shall be black on a white background, or white on a black background. Gage shall be cleaned for oxygen use, labeled for appropriate service, and marked "USE NO OIL". Install with gage cock.
 - 2. For all services downstream of main shutoff valve: Manufactured for oxygen use, labeled for the appropriate service and marked "USE NO

OIL", 40 mm (1-1/2 inch) diameter gage with dial range 1-690 kPa (1-100 psi) for medical air and oxygen.

2.5 STATION OUTLETS

- A. For designated service, consisting of a quick coupler and inlet supply tube. Provide coupler that is non-interchangeable with other services, and leak proof under three times the normal working pressure. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet and inlet securely to rough-in to prevent floating and provide each with a capped stub length of 6 mm (1/4-inch) (10 mm outside diameter) (3/8-inch outside diameter) tubing for connection to supply. Identification of each gas service shall be permanently cast into the back plate and shall be visible through a transparent plastic guard. Label stub tubing for appropriate service.

2.6 STATION OUTLET ROUGH-IN

- A. Flush mounted, protected against corrosion. Anchor rough-in securely to unit or wall construction.
- B. Modular Cover Plate: Die cast back plate, two-piece .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, with mounting flanges on all four sides, secured to rough-in with stainless steel or chromium plated countersunk screws.
- C. Provide permanent, metal or plastic, identification plates securely fastened at each outlet and inlet opening, with inscription for appropriate service using color coded letters and background. Metal plates shall have letters embossed on baked-on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
OXYGEN	White letters on green background
MEDICAL AIR	Black or white letters on yellow

2.7 ALARMS

A. Provide all low voltage control wiring, except for wiring from alarm relay interface control cabinet to ECC, required for complete, proper functioning system, in conformance with Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Run wiring in conduit, in conformance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

B. Alarm Functions:

1. Oxygen and medical air alarms: Pressure alarms: Functions when pressure in branch drops below 275 kPa (40 psi), plus/minus 14 kPa (2 psi) or increases above 414 kPa (60 psi), plus/minus 14 kPa (2 psi) set points; operated by pressure switches or transmitters.
2. Vacuum alarms: Low vacuum alarm: Functions when vacuum in branch drops below 40 kPa (12-inches Hg); operated by vacuum switch.

C. Alarm Panels:

1. General: Modular design, easily serviced and maintained; alarms operate on alternative current low voltage control circuit; provide required number of transformers for efficient functioning of complete system. Alarm panels shall be integral units, reporting oxygen, medical air and vacuum services, as required.
2. Box: Flush mounted, sectional or one piece, corrosion protected. Size to accommodate required number of service functions for each location, and for one audible signal in each box. Anchor box securely. Provide spare capacity to accommodate 50% of the number of provided alarm points.
3. Cover plate: Designed to accommodate required number of signals, visual and audible, for each location, and containing adequate operating instructions within the operator's view. Bezel shall be extruded aluminum, chromium plated metal, or plastic. Secure to the box with chromium plated or stainless steel countersunk screws.
4. Service indicator lights: Red translucent plastic or LED with proper service identification inscribed thereon. Number of lights and service instruction shall be as required for each location. Provide

- each panel with a green test button of the same material, inscribed with "PUSH TO TEST" or similar message.
5. Audible signal: Provide one in each alarm panel and connect electrically with all service indicator light functions.
 6. Controls:
 - a. Visual signal: When the condition occurs which any individual service indicator light is to report, button for particular service shall give a lighted visual signal which cannot be canceled until such condition is corrected.
 - b. Audible signal: Alarm shall give an audible signal upon circuit energization of any visual signal. Audible signal shall be continuous until silenced by pushing a button. This shall cancel and reset audible only, and not affect the visual signal. After silencing, subsequent alarms shall reactivate the audible alarm.
 - c. Signal tester: Test button or separate normal light shall be continuously lighted to indicate electrical circuit serving each individual alarm is energized. Pushing test button shall temporarily activate all visual signals and sound audible signal, thereby providing desired indications of status of system.

2.8 PRESSURE SWITCHES

General purpose, contact or mercury type, allowing both high and low pressure set points, with contact type provided with a protective dust cover; adjustable range set by inside or outside adjustment; switches activate when indicated by alarm requirements. Use one orifice nipple (or DISS demand check valve) for each sensor or pressure switch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. In accordance with current NFPA.
- B. Keep open ends of tube capped or plugged at all times or otherwise sealed until final assembly.
- C. Cut piping square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. Ream

tube to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. Work into place without springing or forcing. Bottom tube in socket so there are no gaps between tube and fitting. Exercise care in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease being introduced into tubing. Where contamination has occurred, material is no longer suitable for oxygen service.

- D. Spacing of hangers: Current NFPA.
- E. Rigidly support valves and other equipment to prevent strain on tube or joints.
- F. While being brazed, joints shall be continuously purged with *oil* free nitrogen. The flow of purged gas shall be maintained until joint is cool to touch.
- G. Do not bend tubing. Use fittings.
- H. Install pressure switches, transmitter and gauges to be easily accessed, and provide access panel where installed above plaster ceiling. Install pressure switch and sensors with orifice nipple between the pipe line and switches/sensors.
- I. Apply pipe labeling during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.
- J. After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency performs final tests.
- K. Provide 40mm (1 1/2 inch) diameter line pressure gage downstream of zone valve in cabinets.
- L. Provide zone valves in cabinets where indicated.

3.2 TESTS

- A. Initial Tests: Blow down, and high and low pressure leakage tests as required by current NFPA with documentation.

B. Healthcare testing agency shall perform the following:

1. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with, current NFPA and the procedures set forth in pre-qualification documentation.
2. Verify that the systems, as installed, meet or exceed the requirements of current NFPA, this specification, and that the systems operate as required.
3. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 35 cubic feet (1000 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 Lpm). Filter shall show no discoloration, and shall accrue no more than 0.1 mg of matter. Test each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.
4. Piping purity test: For each positive pressure system, verify purity of piping system. Test each zone at the most remote outlet for dew point, carbon monoxide, total hydrocarbons (as methane), and halogenated hydrocarbons, and compare with source gas. The two tests must in no case exceed variation as specified in Paragraph, Maximum Allowable Variation. Perform test with the use of an inert gas as described in CGA P-9.
5. Outlet and inlet flow test:
 - a. Test all outlets for flow. Perform test with the use of an inert gas as described in CGA P-9.
 - b. Oxygen and air outlets must deliver 100 Lpm (3.5 scfm) with a pressure drop of no more than 35 kPa (5 psi), and static pressure of 350 kPa (50 psi).

3.3 CONNECTION TO EXISTING GAS SYSTEM:

- A. Contactor shall test the existing system for hydrocarbons, dew point, etc. If problems are present, the resident engineer (RE) would notify the facility of the results. The facility would then make the necessary repairs and/ or maintenance.

- B. Install shut-off valve at the connection of new line to existing line.
- C. Coordinate time for shut-down of the existing healthcare system with the VA medical center.
- D. Shut off all oxygen zone valves and gas riser valves if the section to be connected to cannot be totally isolated from the remainder of the system.
- E. Prior to any work being done, check the new pipeline for particulate or other forms of contamination.
- F. Insure that the correct type of pipe tubing and fittings are being used.
- G. Make a spot check of the existing pipelines in the facility to determine the level of cleanness present.
- H. Reduce the pressure to zero and make the tie-in as quickly as possible. A nitrogen purge is not required since this would require another opening in the pipe.
- I. After the tie-in is made and allowed to cool, slowly bleed the source gas back into the pipeline. Test the work area for leaks with soapy water and repair any leaks.
- J. After all leaks, if any, are repaired and the line is fully recharged, perform blow down and testing. Open the zone that is closest to the main to the system, access the closest outlet to the work, and blow the main through the outlet. After the outlet blows clear into a white cloth, make an additional check at a zone most distant from the work. Perform all required current NFPA tests after connection.

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SECTION 23 05 11
COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 23.
- B. Definitions:
 - 1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
 - 2. Option or optional: Contractor's choice of an alternate material or method.
 - 3. COTR: 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 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
- E. Section 07 84 00, FIRESTOPPING.
- F. Section 09 91 00, PAINTING.
- G. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- H. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- I. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 QUALITY ASSURANCE

- A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC or steam boiler plant construction, as applicable.
- 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. 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.
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 (RE)/Contracting Officers Technical Representative (COTR).
4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
7. Asbestos products or equipment or materials containing asbestos shall not be used.

E. Equipment Service Organizations:

1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located reasonably close 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 RE/COTR for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the RE/COTR at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.
 2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract drawings to the RE/COTR for resolution.
 3. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.

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. 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.
- F. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.
- G. Samples: Samples will not be required, except for insulation or where materials offered differ from specification requirements. Samples shall be accompanied by full description of characteristics different from specification. The Government, at the Government's expense, will perform evaluation and testing if necessary. The Contractor may submit samples of additional material at the Contractor's option; however, if additional samples of materials are submitted later, pursuant to Government request, adjustment in contract price and time will be made as provided under Article CHANGES of Section 00 72 00, GENERAL CONDITIONS.
- H. Layout Drawings:
 - 1. Submit complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Refer to Section 00 72 00, GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION.
 - 2. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed layout drawings of all piping and duct systems.

3. Do not install equipment foundations, equipment or piping until layout drawings have been approved.
4. In addition, for HVAC systems, provide details of the following:
 - a. Mechanical equipment rooms.
 - b. Interstitial space.
 - c. Hangers, inserts, supports, and bracing.
 - d. Pipe sleeves.
 - e. Duct or equipment penetrations of floors, walls, ceilings, or roofs.
- I. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
 1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the 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. For boiler plants, refer to Section 23 21 11, BOILER PLANT PIPING SYSTEMS, for additional requirements.
 6. Wall, floor, and ceiling plates.
- J. HVAC Maintenance Data and Operating Instructions:
 1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
 2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.
- K. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning and Refrigeration Institute (ARI):
430-99.....Central Station Air-Handling Units
- C. American National Standard Institute (ANSI):
B31.1-2004.....Power Piping

- D. Rubber Manufacturers Association (ANSI/RMA):
- IP-20-2007.....Drives Using Classical V-Belts and Sheaves
 - IP-21-1991(1997).....Drives Using Double-V (Hexagonal) Belts
 - IP-22-2007.....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:
 - B31.1-2004.....Power Piping, with Amendments
- G. American Society for Testing and Materials (ASTM):
- A36/A36M-05.....Carbon Structural Steel
 - A575-96(2002).....Steel Bars, Carbon, Merchant Quality, M-Grades R
(2002)
 - E84-07.....Standard Test Method for Burning Characteristics
of Building Materials
 - E119-07.....Standard Test Method for Fire Tests of Building
Construction and Materials
- H. Manufacturers Standardization Society (MSS) of the Valve and Fittings
Industry, Inc:
- SP-58-2002.....Pipe Hangers and Supports-Materials, Design and
Manufacture
 - SP 69-2003.....Pipe Hangers and Supports-Selection and
Application
 - SP 127-2001.....Bracing for Piping Systems, Seismic - Wind -
Dynamic, Design, Selection, Application
- J. National Electrical Manufacturers Association (NEMA):
- MG-1-2006.....Motors and Generators
- K. National Fire Protection Association (NFPA):
- 31-06.....Standard for Installation of Oil-Burning
Equipment
 - 54-06.....National Fuel Gas Code
 - 70-08.....National Electrical Code
 - 85-07.....Boiler and Combustion Systems Hazard Code
 - 90A-02.....Installation of Air Conditioning and Ventilating
Systems
 - 101-06.....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 RE/COTR. Such repair or replacement shall be at no additional cost to the Government.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Government.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
 1. All components of an assembled unit need not be products of same manufacturer.
 2. Constituent parts that are alike shall be products of a single manufacturer.
 3. Components shall be compatible with each other and with the total assembly for intended service.

4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, 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.
 5. Minimum Diameter of V-Belt Sheaves (ANSI/RMA recommendations) in millimeters and inches:

Fractional Horsepower		Standard		High Capacity	
Cross Section	Min. od mm (in)	Cross Section	Min. od mm (in)	Cross Section	Min. od mm (in)
2L	20 (0.8)	A	83 (3.25)	3V	67 (2.65)
3L	38 (1.5)	B	146 (5.75)	4V	180 (7.10)
4L	64 (2.5)	C	239 (9.40)	5V	318 (12.50)
5L	89 (3.5)	D	345 (13.60)		
		E	554 (21.80)		

I. Drive Types, Based on ARI 435:

1. Provide adjustable-pitch or fixed-pitch drive as follows:
 - a. Fan speeds up to 1800 RPM: 7.5 kW (10 horsepower) and smaller.
 - b. Fan speeds over 1800 RPM: 2.2 kW (3 horsepower) and smaller.
2. Provide fixed-pitch drives for drives larger than those listed above.
3. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling, shall be determined by adjustment of a temporary adjustable-pitch motor sheave or by fan law calculation if a fixed-pitch drive is used initially.

2.4 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. 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.
- C. V-belt and sheave assemblies shall be totally enclosed, firmly mounted, non-resonant. Guard shall be an assembly of minimum 22-gage sheet steel and expanded or perforated metal to permit observation of belts. 25 mm (one-inch) diameter hole shall be provided at each shaft centerline to permit speed measurement.
- D. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.

- E. Access for Speed Measurement: 25 mm (One inch) diameter hole at each shaft center.

2.5 LIFTING ATTACHMENTS

- A. 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 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. 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-ready" per NEMA Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.
- F. Motor Efficiency and Power Factor: All motors, when specified as "high efficiency" by the project specifications on driven equipment, shall conform to efficiency and power factor requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION 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" shall comply with EPACT.
- G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

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 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.

2.8 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.
- D. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
 - 1. HVAC 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

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

2.10 GALVANIZED REPAIR COMPOUND

- A. 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. 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.
- C. 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.
- D. 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.
- E. 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.
- F. 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.
- G. 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.

- H. 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 SPECIAL TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the RE/COTR, 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.

2.14 WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 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.

2.15 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. Boiler Control Panel Locations: Locate and orient panels so that operating personnel standing in front of boilers can view the control switches and displays on the panel face. Panels mounted on the sides near the front of fire tube boilers are acceptable.
- D. Boiler and Economizer Access Platforms: Arrange piping and equipment to allow access by a person standing on the platforms to all valves located above the boilers, to boiler manways located on top of the boilers, and to all economizer valves and access panels.
- E. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- F. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- G. 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 RE/COTR where working area space is limited.
 - 2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by RE/COTR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to RE/COTR for approval.
 - 3. Do not penetrate membrane waterproofing.
- H. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- I. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- J. 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.

K. 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.

L. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

M. 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.

N. Install steam piping expansion joints as per manufacturer's recommendations.

O. 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.

- P. Work in Animal Research Areas: Seal all pipe and duct penetrations with silicone sealant to prevent entrance of insects.
- Q. 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.
- R. Inaccessible Equipment:
 - 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost 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 Para. 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 RE/COTR for evaluation prior to actual work.
- G. Restore building to original condition upon completion of rigging work.

3.4 PIPE AND EQUIPMENT SUPPORTS

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

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

G. Floor Supports:

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

3.5 MECHANICAL DEMOLITION

- A. Rigging access, other than indicated on the drawings, shall be provided by the Contractor after approval for structural integrity by the RE/COTR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating plant, 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 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.

3.6 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. Boilers, Burners, Fuel Trains and Accessories: Retain manufacturer's factory finish. Touch up or recoat as necessary to provide smooth, even-colored and even-textured finish.
 - 6. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
 - 7. Paint shall withstand the following temperatures without peeling or discoloration:
 - a. Boiler stack and breeching -- 65 degrees C (150 degrees F) on insulation jacket surface and 315 degrees C (600 degrees F) on metal surface of stacks and breeching.
 - b. Condensate and feedwater -- 38 degrees C (100 degrees F) on insulation jacket surface and 120 degrees C (250 degrees F) on metal pipe surface.
 - c. Steam -- 52 degrees C (125 degrees F) on insulation jacket surface and 190 degrees C (375 degrees F) on metal pipe surface.
 - 8. 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 RE/COTR in unopened containers that are properly identified as to application.
- C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.10 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.

3.11 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 Section 23 08 11, DEMONSTRATIONS AND TESTS FOR BOILER PLANT, and submit the test reports and records to the RE/COTR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and

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

3.12 DEMONSTRATIONS AND TESTS, TEMPORARY BOILER PLANT EQUIPMENT

- A. Test prior to placing in service.
- B. Demonstrate to RE/COTR the proper operation of all equipment, instruments, operating and safety controls, and devices.
- C. Demonstrate to RE/COTR the proper operation of burners.
 - 1. Emissions within limits specified for new boilers on this project.
 - 2. Stable flame at all operating points with no pulsations.
 - 3. Smooth flame light off, with no delays, puffs or flashbacks.
 - 4. Turndown capability as specified.
- D. Develop full steam output capacity required.
- E. New Boilers Installed in Temporary Location:
 - 1. Perform all tests required by boiler specification.
 - 2. Perform complete retest after boiler is placed in its permanent location.

- - - E N D - - -

SECTION 23 05 12
GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Basic methods and requirements for Division 15, MECHANICAL, applies to all sections of Division 15.
- 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.

1.2 NOT USED

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. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 1 year prior to bid opening. Provide list of users upon request.
 - 2. Equipment having less than a one-year use record, which in the opinion of the Project Engineer, provides significant benefits to the Government such as improved energy efficiency, will be acceptable if it is a product of a manufacturer who has been regularly engaged in the manufacture of that specific type of product which has been used in similar applications for a period of one year. The Project Engineer reserves the right to require the contractor to submit evidence to this effect for his approval.
 - 3. Equipment Service: Products shall be supported by a service organization which maintains an adequate inventory of repair parts and is located, in the opinion of the Project Engineer, reasonably close to the site.
 - 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.
- B. Welding: Before any welding is performed, submit a copy of the "Hot Work Permit" for approval to the project manager prior to beginning for approval, with the Procedure Qualification Record as required by Section 9 of the ASME Boiler and Pressure Vessel Code.
1. Before any welder performs any welding, submit a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests as required by Section 9 of the ASME Boiler and Pressure Vessel Code. The letter or symbol (as shown on the qualification test form) shall be used to identify the work of that welder and shall be affixed, in accordance with appropriate construction code, to each completed weld.
2. The types and extent of non-destructive examinations required for pipe welds are shown in Table 136.4 of the Code for Pressure Piping, ANSI/ASME B31.1.
- 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 Project 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. Guaranty: Section 01001, GENERAL CONDITIONS.
- E. Plumbing Systems: NAPHCC National Standard Plumbing Code.

1.4 SUBMITTALS

In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, furnish the following:

- A. Manufacturer's Literature and Data: May be submitted 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 Project Engineer.
2. Submit electric motor data with the driven equipment.
3. Equipment and materials identification.
4. Firestopping materials.
5. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
6. Wall, floor, and ceiling plates.

- B. Coordination Drawings: In accordance with GENERAL CONDITIONS, Paragraph, SUBCONTRACTS AND WORK COORDINATION.
1. Mechanical equipment rooms.
 2. Hangers, inserts, supports, and bracing.
 3. Pipe sleeves.
 4. Duct or equipment penetrations of floors, walls, ceilings, or roofs.
- C. Maintenance Data and Operating Instructions:
1. Maintenance and operating manuals in accordance with Section 01 01 00, GENERAL REQUIREMENTS, Paragraph, 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.
- D. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

1.5 APPLICABLE PUBLICATIONS

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

- A. Federal Specifications (Fed. Spec.):
FF-S-325.....Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry).
- B. Military Specifications (Mil. Spec.):
DOD-P-21035A.....Paint, High Zinc Dust Content Galvanizing Repair.
- C. Air Conditioning and Refrigeration Institute (ARI):
435-81.....Standard For Application of Station Air - Handling Units.
- D. American National Standard Institute (ANSI) Specifications:
B31.1-83.....Code for Pressure Piping - Power Piping Rubber Manufacturers Association (ANSI/RMA):
IP-20-77.....Drives Using Classical Multiple V-Belts A, B, C, D, and E Cross Sections) (ANSI/RMA)
IP-21-84.....Drives Using Double V-Belts (AA, BB, XX, DD Cross Sections) (ANSI/RMA)
IP-22-83.....Drives Using Narrow Multiple V-Belts (3V, 5V, and 8V Cross Sections)(ANSI/RMA)
- E. Air Moving and Conditioning Association (AMCA):
410-75.....Recommended Safety Practices for Air Moving Devices

- F. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Code: Section 9-83, Welding and Brazing Qualifications - 1986
- G. American Society for Testing and Materials (ASTM):
 - E84-84.....Surface Burning Characteristics of Building Materials
 - E119-83.....Fire Tests of Building Construction and Materials
- H. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
 - SP-58-83.....Pipe Hangers and Supports Materials. Design and Manufacture
 - SP-69-83.....Pipe Hangers and Supports Selection and Application
- I. National Association of Plumbing - Heating - Cooling Contractors (NAPHCC):
 - 1983.....National Standard Plumbing - 1983 Code - Supplement 84-85
- J. National Fire Protection Association (NFPA):
 - 90-85.....Installation of Air Conditioning and Ventilating Systems
 - 101-85.....Life Safety Code

PART 2 - PRODUCTS

2.1 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: RMA Standard IP-20 and IP-21.
- C. Minimum Horsepower Rating: Motor horsepower plus recommended RMA service factor (not less than 20 percent) in addition to the RMA allowances for pitch diameter, center distance, and arc of contact.
- D. Maximum Speed: 5000 feet per minute.
- E. Adjustment Provisions: For alignment and 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 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.
 - 5. Minimum Diameter of V-Belt sheaves (RMA recommendations):

Fractional Horsepower		Standard		High Capacity	
Cross Section	Min. od Inches	Cross Section	Min. od Inches	Cross Section	Min. od Inches
2L	0.8	A	3.25	3V	2.65
3L	1.5	B	5.75	4V	7.10
4L	2.5	C	9.40	5V	12.50
5L	3.5	D	13.60		
		E	21.80		

I. Drive Types, Based on ARI Standard 435:

1. Provide adjustable-pitch or fixed-pitch drive as follows:
 - a. Fan speeds up to 1800 RPM: 10 horsepower and smaller.
 - b. Fan speeds over 1800 RPM: 3 horsepower and smaller.
2. Provide fixed-pitch drives for drives larger than those listed above.
 - a. 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.

2.2 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. Drive guards may be excluded where motors and drives are inside factory fabricated air handling unit casings.
- B. 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.
- C. Access for Speed Measurement: One inch diameter hole at each shaft center.

2.3 ELECTRIC MOTORS

Provide premium efficient motors. Unless otherwise specified for a particular application use electric motors with the following requirements.

- A. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans may be split phase or permanent split capacitor (PSC).
- B. Polyphase Motors: NEMA Design B, Squirrel cage, induction type. Each two speed motor shall have two separate windings.
- C. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees centigrade; minimum horsepower as shown on drawings; maximum

horsepower in normal operation not to exceed nameplate rating without service factor.

- D. Insulation Resistance: Not less than one-half megohm between stator conductors and frame, to be determined at the time of final inspection.

2.4 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and in the maintenance manuals.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 3/16-inch high of brass with black-filled letters, or rigid black plastic with white letters permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- D. Valves Tags and Lists:
1. HVAC: Provide for all valves.
 2. Valve tags: Engraved black filled numbers and letters not less than 1/2-inch high for number designation, and not less than 1/4-inch for service designation on 19 gage 1-1/2 inches round brass disc, attached with brass "S" hook or brass chain. All valves installed will have attached a printed bar code label supplied by the V.A. Hospital Engineering Section. The label will identify valve type grid cross-reference-sequential number.
 3. Valve lists: Typed or printed plastic coated card(s), sized 8-1/2 inches by 11 inches showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.

2.5 NOT USED

2.6 GALVANIZED REPAIR COMPOUND:

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

2.7 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. For Attachment to Concrete Construction:
1. Self-drilling expansion shields and machine bolt expansion anchors: Fed. Spec. FF-S-325, permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed in Fed. Spec. FF-S-235.
 2. Power-driven fasteners are not allowed.
- B. 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 7/8-inch outside diameter.
- C. Hanger Rods: Hot-roller 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 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- D. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-1/2 inches by 1-1/2 inches, No. 12 gage, designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping, fire and sprinkler piping, or chemical waste drain piping.
 1. Allowable hanger load: Manufacturers rating less 200 pounds.
 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 1/2-inch galvanized steel bands, for insulated piping at each hanger.
- E. Pipe Hangers and Supports: (MSS-SP-58), use hangers sized to encircle insulation on insulated piping. To protect insulation, provide Type 39 saddles for roller type supports. Provide Type 40 insulation shield at all other types of supports and hangers including those for preinsulated 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. For uninsulated copper tube: Hangers, clamps and other support material in contact with tubing shall be copper plated to prevent electrolysis.
 2. HVAC Piping (Other Than General Types):
 - a. Spring Supports (Expansion and contraction of vertical piping):
 - 1) Movement up to 3/4-inch: Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
 - 2) Movement more than 3/4-inch: Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
 3. Plumbing piping (Other Than General Types):

- a. Sprinkler system: UL or Factory Mutual approved types.
 - b. Horizontal piping: Type 1, 5, 7, 9, and 10.
 - c. Chrome plated piping: Chrome plated supports.
 - d. 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.
 - e. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 18 gage minimum.
- F. Seismic Restraint of Piping:
- 1. Provide as shown on the drawings and per SMACNA Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems. Design criteria is as follows:
 - a. Piping resiliently supported: 100 percent of the weight of the system components and contents.
 - b. Piping not resiliently supported: 50 percent of the weight of the system components and contents.
 - 2. Pre-engineered, catalogued pipe restraint products, including the slack cable method, may be submitted for consideration as an approved deviation from the methods shown.
 - 3. Restraint designs shall be signed by a registered structural engineer with experience on at least three projects with similar bracing work.

2.8 PIPE PENETRATIONS:

Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.

- A. 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.
- B. Sleeve Clearance: Sleeve through floors, walls, and partitions, 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 firestopping material and sealant to prevent the spread of fire, smoke, and gases.

2.9 TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the Project 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 Project Engineer.
- D. Lubricants: A minimum of one quart of oil, and 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of 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 Project Engineer. Damaged or defective items in the opinion of the Project 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 clean, exposed materials and equipment.
- C. Concrete and Grout: Use concrete and shrink compensating grout 3000 psi minimum.
- D. 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. 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 01010, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
 - 2. As specified in Section 01010, 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. See drawings for further requirements.

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

3.2 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 Project 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 and red lead paint products that are rusty.
- 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 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, and other heavy components. Provide a support within one foot of each elbow.
- E. Plumbing horizontal and vertical pipe supports, refer to the NAPHCC National Standard Plumbing Code.

3.3 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.

3.4 LUBRICATION

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

3.5 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 01010, GENERAL REQUIREMENTS, paragraph, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.6 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, perform required tests as specified in Section 01010, GENERAL REQUIREMENTS, Article TESTS and submit the test reports and records to the Project 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.

3.7 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 identity marker options or stencil applied painted on.
 - 2. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12 000 mm (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.
 - 3. Locate Legends clearly visible from operating position.
 - 4. Use arrow to indicate direction of flow.
 - 5. Identify pipe contents with sufficient additional details such as temperature, pressure, and contents to identify possible hazard. Insert working pressure shown on drawings where asterisk appears for High, Medium, and Low Pressure designations as follows:
 - a. High Pressure - 414 Kpa (60 psi) and above
 - b. Medium Pressure - 104 to 413 Kpa (15 to 59 psi).

c. Low Pressure - 103 Kpa (14 psi) 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. W. Sup.
A/C Condenser Water Return		Green	White	A/C Cond. W. Ret.
Chilled Water Supply		Green	White	Ch. W. Sup.
Chilled Water Return		Green	White	Ch. W. Ret.
Shop Compressed Air		Yellow	Black	S. 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 W. Sup.
High Temperature Water Return		Yellow	Black	H. Temp W. 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		Green	White	Fuel Oil-Grade ____*
Boiler Water Sampling		Yellow	Black	Sample
Chemical Feed		Yellow	Black	Chem.
Continuous Blow Down		Yellow	Black	Cont. B. D.
Condensate Pumped			Black	Cond. - Pump
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. Wat.
Ice Water				
Supply	White	Green	White	Ice W.
Return	White	Green	White	Ice W. 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 Disc.
Chemical Resistant Pipe				
Waste		Yellow	Black	Acid Waste
Vent		Yellow	Black	Acid Vent
Athmospheric Vent		Green	White	ATV
Silver Recovery		Green	White	Sil. 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

END OF SECTION

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

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.
- B. Flexible Pipe Connectors to Reciprocating and Rotating Mechanical Equipment.
- C. Optional Air Handling Unit Internal Vibration Isolation.
- D. Flexible Duct Connectors, Sound Attenuators and Sound Absorbing Duct Lining.
- E. Sound Tests and Vibration Tests.

1.3 QUALITY ASSURANCE

- A. Refer to article, QUALITY ASSURANCE in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.
- B. Noise Criteria: See Table 1-5 below:

Table 1-5 Noise Level

Type of Rooms	NC Level
Patient	35
Examination Room, Endoscopy and Bronchoscopy	35
Audio Suites, Audio Speech Pathology	35
Phono/Cardiology	35
Chapels	40
Conference	35
Auditorium, Theaters	40
Operating Rooms (Major and Minor)	35
Offices, Small Private	40
Offices, Large Open	35
Pharmacy	40
Lobbies, Waiting Areas	35
Treatment	40
Corridors, Nurse Stations	40
Bathrooms, Toilets	40
Laboratories	45
SPD, Dining, Food Service/Serving	45
Therapeutic Pools	45
Laundries	50
Gymnasiums, Recreation Rooms	50
X-Rays and General Work Rooms	40
Laundries	50
All Other Occupied Areas	35-40*

1. Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed NC 35 within the occupied room.
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 1987 Systems Handbook, Chapter 52, SOUND AND VIBRATION CONTROL. An average value of 5 db shall be used as the room attenuating effect, i.e., the difference between sound power level emitted to room and sound pressure level in room.
3. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.

C. Seismic Restraint Requirements:

1. For 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.
2. For piping and ductwork: Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.

- D. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 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 Section 01 33 23, SAMPLES AND SHOP DRAWINGS.
- B. Manufacturer's Literature and Data:
 1. Vibration isolators:
 - a. Floor mountings.
 - b. Hangers.
 - c. Snubbers.

- d. Thrust restraints.
- 2. Seismic restraint provisions and bolting.
- C. Isolator manufacturer shall furnish with submittal load calculations for selection of isolators, including supplemental bases, based on lowest operating speed of equipment supported.
- D. Seismic Requirements: Submittals are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, standard connections, manufacturer's recommendations, behavior problems (vibration, thermal, expansion etc.) associated with equipment or piping.

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):
Systems Handbook 1987, Chapter 52, Sound and Vibration Control.
- C. American Society for Testing and Materials (ASTM):

A123-89.....Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A307-90.....Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

D2240-86.....Rubber Property - Durometer Hardness
- D. Manufacturers Standardization (MSS):

SP-58-88.....Pipe Hangers and Supports-Materials, Design and Manufacture
- E. Occupational Safety and Health Administration (OSHA):

1910.....Occupational Noise Exposure

PART 2 - PRODUCTS

2.1 GENERAL

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 in the schedule on the drawings.

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. Captive Spring Mount for Seismic (Type SS):
 - a. Design mounts to resiliently resist seismic forces in all directions. Snubbing shall take place in all modes with adjustment to limit upward, downward, and horizontal travel to a maximum of 1/4-inch before contacting snubbers. Mountings shall have a minimum rating of one G as calculated and certified by a registered structural engineer.
 - b. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection. Mountings shall have ports for spring inspection. Provide an all directional neoprene cushion collar around the equipment bolt.
 3. Spring Isolators with Vertical Limit Stops (Type SP): Similar to spring isolators preceding, except include a vertical limit stop to limit upward travel if weight is removed and also to reduce movement due to wind loads. Provide clearance around restraining bolts to prevent mechanical short circuiting. Isolators shall have a minimum seismic rating of one G.
- 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. Hanger supports for piping 2-inches and larger shall have a pointer and scale deflection indicator.

2.3 GENERAL ISOLATOR REQUIREMENTS:

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

2.4 SEISMIC RESTRAINT REQUIREMENTS FOR EQUIPMENT

- A. Bolt equipment, without vibration isolators, to support using ASTM A307 standard bolting material; or, equal.
- B. On all sides of suspended equipment, provide bracing for rigid supports and provide restraints for resiliently supported equipment. The slack cable restraint method, Mason Industries, or approved equal, is acceptable.

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.
 - 3. Provide heat shields where elastomers are subject to temperatures over 100 degrees F.
- 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.

- - - E N D - - -

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING

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

1.2 RELATED WORK

- A. General Mechanical Requirements: Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL).
- B. Noise and Vibration Requirements: Section 15200, NOISE AND VIBRATION CONTROL.

- C. Piping and Equipment Insulation: Section 15250, INSULATION.
- D. Duct Leakage: Section 15840, DUCTWORK AND ACCESSORIES.

1.3 QUALITY ASSURANCE

- A. Refer to Articles, Quality Assurance and Submittals, in Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL).
- 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 Project 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.
- C. Test Equipment Criteria: The basic instrumentation requirements and accuracy/calibration required 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 90 percent of final 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. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 2 percent to plus 10 percent except if the air to a space is 100 CEM or less the tolerance would be 0 to plus 5 percent.
 - d. Chilled and heating hot water coils: 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 Project Engineer for one air distribution system (including all fans, three terminal units, three rooms) 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 01340, SAMPLES AND SHOP DRAWINGS.
- 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 Project Engineer staff, submit one complete set of applicable AABC or NEBB publications that will be the basis of TAB work.
- D. Submit Following Reports for Review and Approval:
 - 1. Systems inspection report on equipment and installation for conformance with design.
 - 2. Duct Air Leakage Test Report.
 - 3. Systems Readiness Report. Actual equipment technical data and as-built drawings shall be reviewed completeness and shall be used in carrying out TAB report.
 - 4. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
 - 5. Pre-construction air and water balance report.
 - 6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.

1.5 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic

designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
 - 1999 HVAC Applications ASHRAE Handbook, Chapter 36, Testing, Adjusting, and Balancing and Chapter 46, Sound and Vibration Control
- B. Associated Air Balance Council (AABC):
 - 2002 AABC National Standards for Total System Balance
- C. National Environmental Balancing Bureau (NEBB):
 - 6th Edition 1998 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
 - 3rd Edition 2001 Procedural Standards for the Measurement and Assessment of Sound and Vibration
- D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 2nd Edition 1993 HVAC SYSTEMS-Testing, Adjusting and Balancing

PART 2 - PRODUCTS

2.1 PLUGS

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

2.2 INSULATION REPAIR MATERIAL

See Section 15250, 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 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 flexible duct sizes and routing.

3.3 DUCT AIR LEAKAGE TEST REPORT

See paragraphs "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.

3.4 SYSTEM READINESS REPORT

- A. Inspect each System to ensure that it is complete including installation and operation of controls.
- B. Verify that all items such as ductwork piping, ports, terminals, connectors etc. required for TAB are installed and provide a report to the Project Engineer.

3.5 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 Project 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.
- D. Do not proceed with the remaining systems until intermediate report is approved by the Project Engineer.

3.6 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 any phased construction completion requirements for the project. Provide TAB reports for each phase of

the project prior to partial final inspections of each phase of the project.

- D. Allow sufficient 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. Artificially load air filters by partial blanking to produce air pressure drop of at least 90 percent of the design final pressure drop.
 - 2. Adjust fan speeds to provide design air flow. V-belt drives, including fixed pitch pulley requirements, are specified in Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL).
 - 3. Test and balance systems in all specified modes of operation. Verify that dampers and other controls function properly.
 - 4. Record final measurements for air handling equipment performance data sheets.
- F. Water Balance and Equipment Test: Include circulating pumps, and coils.
 - 1. Record final measurements for hydronic equipment performance data sheets. Include entering and leaving water temperatures for heating and cooling coils. 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.
 - 2. Adjust flow rates for equipment, coils and evaporator for instance, to values on equipment submittals if different from values on contract drawings.
- G. All equipment needed to simulate the anticipated load shall be provided to ensure that the installed HVAC equipment meets the design requirements.

3.7 VIBRATION TESTING

- A. Furnish instruments and perform vibration measurements as specified in Section 15200, NOISE AND VIBRATION CONTROL. Field vibration balancing is specified in Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL). Provide measurements for all rotating HVAC equipment of 373 watts (1/2 horsepower) and larger, including pumps, fans and motors.
- B. Record initial measurements for each unit of equipment on test forms and submit a report to the Project Engineer. Where vibration readings exceed the allowable tolerance Contractor shall correct the problem, the TAB agency shall verify after the corrections are done and submit a final report to the Project Engineer.

3.8 SOUND TESTING

- A. Perform and record required sound measurements in accordance with Paragraph, QUALITY ASSURANCE in Section 15200, NOISE AND VIBRATION CONTROL. Take readings in rooms, approximately ten (10) percent of the total rooms. The Project Engineer shall 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, formulae 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 15200, NOISE AND VIBRATION CONTROL:
 - 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 pressure levels with specified equipment "on."
 - d. Use the DIFFERENCE in corresponding readings to determine the sound pressure due to equipment.

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

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

- e. Plot octave bands of sound pressure level due to equipment for typical rooms on a graph which also shows noise criteria (NC) curves.
2. When sound power levels are specified:
 - a. Perform steps 1.a. thru 1.d., as above.
 - b. For indoor equipment: Determine room attenuating effect, i.e., difference between sound power level and sound pressure level. Determined sound power level will be the sum of sound pressure level due to equipment plus the room attenuating effect.
 - c. For outdoor equipment: Use directivity factor and distance from noise source to determine distance factor, i.e., difference between sound power level and sound pressure level. Measured sound power level will be the sum of sound pressure level due to equipment plus the distance factor. Use 10 meters (30 feet) for sound level location.

3. Where sound pressure levels are specified in terms of dB(A), measure sound levels using the "A" scale of meter. Single value readings will be used instead of octave band analysis.
- E. Where measure sound levels exceed specified level, the installing contractor or equipment manufacturer shall take remedial action approved by the Project Engineer and the necessary sound tests shall be repeated.

3.9 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 Project Engineer.

3.10 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.

-- End of Section --

SECTION 23 07 11
HVAC, PLUMBING, AND BOILER PLANT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field applied insulation for thermal efficiency and condensation control for HVAC and plumbing 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,
 - 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, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
 - 6. FSK: Foil-scrim-kraft facing.
 - 7. Hot: HVAC Ductwork handling air at design temperature above 16 degrees C (60 degrees F); HVAC and plumbing equipment or piping handling media above 41 degrees C (105 degrees F); Boiler Plant breechings and stack temperature range 150-370 degrees C (300-700 degrees F) and piping media and equipment 32 to 230 degrees C (90 to 450 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. HPS: High pressure steam (415 kPa [60 psig] and above).
13. HPR: High pressure steam condensate return.
14. MPS: Medium pressure steam (110 kPa [16 psig] thru 414 kPa [59 psig]).
15. MPR: Medium pressure steam condensate return.
16. LPS: Low pressure steam (103 kPa [15 psig] and below).
17. LPR: Low pressure steam condensate gravity return.
18. HWH: Hot water heating supply.
19. HWHR: Hot water heating return.
20. CW: Cold water.
21. HW: Hot water.
22. CH: Chilled water supply.
23. CHR: Chilled water return.

1.2 RELATED WORK

- A. Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT: Insulation containing asbestos material.
- B. Section 02 82 13.13, GLOVEBAG ASBESTOS ABATEMENT: Insulation containing asbestos material.
- C. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- D. 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.
- E. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING and Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.
- F. Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING: Piping and equipment.
- G. Section 23 21 13, HYDRONIC PIPING: Chilled water piping.
- H. Section 23 31 00, HVAC DUCTS AND CASINGS: Ductwork, plenum and fittings.

1.3 QUALITY ASSURANCE

- A. Refer to article QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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 4.3.3.1.2 or 4.3.3.1.3, 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.

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.

4.3.3.1.3 Smoke detectors required by 6.4.4 shall not be required to meet flame spread index or smoke developed index requirements.

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.

4.3.10.2.6.3 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.

4.3.10.2.6.4 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.

4.3.10.2.6.5 Loudspeakers and recessed lighting fixtures, including their assemblies and accessories, shall be permitted in the ceiling cavity plenum where listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a peak heat release rate of 100 kW or less when tested in accordance with UL 2043, Standard for Safety Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

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

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

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)-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):
- A167-99.....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- B209-04.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C411-97.....Standard test method for Hot-Surface
Performance of High-Temperature Thermal
Insulation

C449-00.....Standard Specification for Mineral Fiber
Hydraulic-Setting Thermal Insulating and
Finishing Cement

C533-04.....Standard Specification for Calcium Silicate
Block and Pipe Thermal Insulation

C534-05.....Standard Specification for Preformed Flexible
Elastomeric Cellular Thermal Insulation in
Sheet and Tubular Form

C547-06.....Standard Specification for Mineral Fiber pipe
Insulation

C552-03.....Standard Specification for Cellular Glass
Thermal Insulation

C553-02.....Standard Specification for Mineral Fiber
Blanket Thermal Insulation for Commercial and
Industrial Applications

C585-90.....Standard Practice for Inner and Outer Diameters
of Rigid Thermal Insulation for Nominal Sizes
of Pipe and Tubing (NPS System) R (1998)

C612-04.....Standard Specification for Mineral Fiber Block
and Board Thermal Insulation

C1126-04.....Standard Specification for Faced or Unfaced
Rigid Cellular Phenolic Thermal Insulation

C1136-06.....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

E84-06.....Standard Test Method for Surface Burning
Characteristics of Building
Materials

E119-05a.....Standard Test Method for Fire Tests of Building
Construction and Materials

E136-04.....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-02.....Installation of Air Conditioning and
Ventilating Systems

96-04.....Standards for Ventilation Control and Fire
Protection of Commercial Cooking Operations

101-06.....Life Safety Code

251-06.....Standard methods of Tests of Fire Endurance of
Building Construction Materials

255-06.....Standard Method of tests of Surface Burning
Characteristics of Building Materials

F. Underwriters Laboratories, Inc (UL):

723.....UL Standard for Safety Test for Surface Burning
Characteristics of Building Materials with
Revision of 08/03

G. Manufacturer's Standardization Society of the Valve and Fitting
Industry (MSS):

SP58-2002.....Pipe Hangers and Supports Materials, Design,
and Manufacture

PART 2 - PRODUCTS

2.1 MINERAL FIBER

- A. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation),
Class 1, k = 0.037 (0.26) for use at temperatures 230 degrees C (450
degrees F).

2.2 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance \leq 0.02 or less
perm rating, Beach puncture 50 units for insulation facing on exposed
ductwork, casings and equipment, and for pipe insulation jackets.
Facings and jackets shall be all service type (ASJ) or PVDC Vapor
Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick
aluminum foil, fiberglass reinforced, with pressure sensitive adhesive
closure. Comply with ASTM C1136. Beach puncture 5 units, Suitable for
painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch)

lap on longitudinal joints and minimum 100 mm (4 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. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.
- E. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.

2.3 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).

2.4 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 or Type II: Vapor barrier compound for indoor use.
- E. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.
- F. Other: Insulation manufacturers' published recommendations.

2.5 MECHANICAL FASTENERS

- A. Pins, anchors: Welded pins, or metal or nylon anchors with tin-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching monel or stainless 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: 20 mm (3/4 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.6 FIRESTOPPING MATERIAL

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

2.7 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. Where removal of insulation of piping, ductwork 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. 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. 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, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 20 mm (3/4 inch) and smaller, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.
 - 5. Equipment:
 - a. Condensate return pump units
 - e. Safety valves
 - 6. Specialties:
 - a. Pressure reducing valves

- b. Control valves-water and steam
- c. Level sensors-piping, valves and blowdown
- e. Strainers under 65 mm (2-1/2 inch) pipe size
- H. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- I. 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.
- J. 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

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, and duct work exposed to outdoor weather:
 - a. 40 mm (1-1/2 inch) thick insulation faced with ASJ: Return air duct, mixed air plenums and prefilter housing.
 - b. Outside air intake ducts: no insulation required
 4. Supply air duct in the warehouse and in the laundry: 25 mm (one inch) thick insulation faced with ASJ.
- B. Flexible Mineral Fiber Blanket:
 1. Adhere insulation to metal with 100 mm (4 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: 50 mm (2 inch) thick insulation faced with FSK.

- b. Above ceilings for other than roof level: 40 mm (1-1/2 inch) thick insulation faced with FSK.
- 4. Concealed return air duct 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. Concealed return air ductwork in other locations need not be insulated.
- 5. Return air duct in interstitial spaces: 40 mm (1-1/2 inch thick insulation faced with FSK.
- 6. Concealed outside air duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.
- 7. 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 table below, for piping above ground:

Nominal Thickness of Molded Mineral Fiber Insulation				
Nominal Pipe Size, millimeters (inches):	25 (1) & below	32- 75 (1-1/4- 3)	100-150 (4-6)	200 (8) and above
a. 122-177 degrees C (251-350 F) (HPS, MPS,)	50 (2.0)	65 (2.5)	90 (3.5)	90 (3.5)
b. 100-121 degrees C HPR, MPR (212-250 degrees F) (Vent piping from PRV safety valves, condensate receivers, and flash tanks)	25 (1.0)	50 (2.0)	50 (2.0)	50 (2.0)
c. 38-99 degrees C (100- 211 degrees F) (LPR, PC, HWH, HWHR, GH, GHR)	25 (1.0)	40 (1.5)	50 (2.0)	50 (2.0)
1. Runouts to fan coil units	15 (0.5)	-	-	-
2. Runouts to reheat coils air terminal unit reheat coils	15 (0.5)	-	-	-
d. Domestic hot water supply and return	15 (0.5)	20(0.75)	25 (1.0)	40 (1.5)

D. Rigid Cellular Phenolic Foam:

1. Rigid closed cell phenolic insulation may be provided for piping, ductwork and equipment for temperatures up to 121 degrees C (250 degrees F).
2. Note the NFPA 90A burning characteristics requirements of 25/50 in paragraph 1.3.B

3. Provide secure attachment facilities such as welding pins.
4. Apply insulation with joints tightly drawn together
5. Apply adhesives, coverings, neatly finished at fittings, and valves.
6. Final installation shall be smooth, tight, neatly finished at all edges.
7. Minimum thickness in millimeters (inches) specified in table below, for piping above ground:

Nominal Thickness of Rigid Closed-Cell Phenolic Foam Insulation					
Nominal Pipe Size millimeters (inches):	25 (1) & below	32-75 (1 1/4-3)	100-150 (4-6)	200-300 (8-12)	350 (14) & above
1. 100-121 degrees C (212-250 degrees F), LPS, Vent piping from receivers and flash tanks.	15 (0.5)	25 (1)	25 (1)	--	--
2. 38-99 degrees C (100- 211 degrees F), LPR, PC, HWH, HWHR, GH and GHR.	15 (0.5)	20 (0.75)	25 (1)	--	--
a. Run outs to Fan Coil units reheat coils.	15 (0.5)	--	--	--	--
3. 4-16 degrees C (40-60 degrees F), CH, CHR, GC, and GCR.	20 (0.75)	20 (0.75)	25 (1)	40 (1.5)	50 (2.0)
a. Run outs to Fan Coil Units.	15 (0.5)	--	--	--	--
b. Ice Water Piping	15 (0.5)	20 (0.75)	25 (1)	--	--
4. 10 degrees C (50 degrees F) and less, RS for DX refrigerants.	15 (0.5)	20 (0.75)	--	--	--
5. Domestic hot water supply and return.	15 (0.5)	15 (0.5)	20 (0.75)	20 (0.75)	--

8. Condensation control insulation: Minimum 20 mm (0.75 inch) thick for all pipe sizes.
 - a. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.

E. Cellular Glass Insulation:

1. Pipe and tubing, covering nominal thickness in millimeters and inches as tabulated below for chilled water and refrigerant piping.

Nominal Thickness of Cellular Glass Insulation				
Millimeters (inches)	Thru 38 (1 1/2)	50- 150 (2-6)	200-300 (8-12)	over 350 (14)
1. 4-16 degrees C (40-60 degrees F) (CH and CHR within chiller room and pipe chase and underground)	50 (2.0)	80 (3.0)	80 (3.0)	100 (4.0)
2. 4-16 degrees C (40-60 degrees F) (CH and CHR outside chiller room)	40 (1.5)	50 (2.0)	50 (2.0)	65 (2.5)

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SECTION 23 09 11
CONTROLS AND INSTRUMENTATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Control devices and systems to provide the functional requirements of these specifications and as shown on the contract drawings.

1. Direct Digital Control (DDC) of HVAC equipment and systems with electric positioning of valves.
2. Electric or electronic control of coils and air handling units.
3. Connect the new work to the nearest existing Johnson Controls NAE controller located at fifth floor interstitial space. Actual point of connection shall be verified by the contractor and shall be coordinated with VA Project Manager.

D. Definitions:

1. 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.
2. Analog: A continuously varying signal value (temperature, current, velocity, etc.)
3. Baud: A Baud is a single 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 = 1200 Baud/sec is 1200 bits/sec if one signal change = 1 bit.
4. Binary: A two-state system where an "on" condition is represented by a high signal level and an "off" condition is represented by a low signal level.
5. Control units (CU's): The CU is the microcomputer by which the direct digital control algorithms are processed. The CU may also include the input and output data processing function also.
6. Control Wiring: Includes conduit, wire and wiring devices to install complete HVAC control systems including motor control circuits, interlocks, thermostats, PE and EP switches and like devices. Includes all wiring from a DDC cabinet to all sensors and points defined in the input/output summary shown on drawings and required to execute the sequence of operation.
7. DCP (Distributed Control Panel): Panels which house the DDC control unit (CU), input and output functions, power supplies, relays, transducers and other required hardware.
8. DDC (Direct Digital Control): A control loop in which a digital controller periodically updates the process as a function of a set of measured control variables and a given set of control algorithms.

9. Deadband: A temperature range over which no heating or cooling is supplied, such as 72-78 degrees F, i.e., as opposed to single point changeover or overlap.
10. Diagnostic Program: Machine-executable instructions used to detect and isolate system and component malfunctions.
11. Distributed Control System: A system whereby control processing is decentralized and independent of a central computer. Operational control, processing and data are distributed to computers throughout the system. Little functionality is lost in any processor on the network if communication is lost with other processors. Distributed control usually implies distributed processing and distributed data.
12. Downline Load: The electronic transfer of programs and data files from a central computer, with secondary memory devices, to remote, distributed computers in a distributed system. Transfer is made over the distributed system's communication network.
13. Engineering Control Center (ECC): Central operator's terminal including the DDC central computer/CRT, keyboard, printer and central intercom.
14. Input/Output (I/O): Input and output functions of the DDC control unit (CU).
15. Man-machine Interface: A method by which an operator is capable of communicating with a DDC system. Man-machine interfacing allows an operator to command, monitor, and program the system.
16. Network: A system of distributed control units that are linked together on a communications channel. A network allows sharing of point information between all control units. Additionally, a network provides central monitoring and control of the entire system from any distributed control unit location.
17. Operating System (OS): Software which controls the execution of computer programs and which provides scheduling, debugging, input/output controls, accounting, compilation, storage assignment, data management, and related services.
18. Peripheral: Input/output equipment used to communicate with the computer and make copies of system outputs. Peripherals include CRT, printer, tape deck, diskette, etc.

1.2 RELATED WORK

A. Section 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT BASIC METHODS AND REQUIREMENTS (MECHANICAL).

1.3 QUALITY ASSURANCE

A. Criteria:

1. Single Source Responsibility of Supplier: All hardware and software supplied under this section shall be the responsibility of the controls contractor. The contractor shall also be responsible for the complete installation and proper operation of the system including debugging and calibration of the CU and all software. The control system contractor must be a direct, wholly owned branch of a

national controls manufacturer, not a representative or a distributor.

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 Control System Contractor shall provide a list of no less than five similar projects which have building control systems as specified. These projects must be on-line and functional such that the VA's representative would observe a direct digital control system in full operation.
4. Maintenance Service Contract by Supplier: Established program to be available to VA following the warranty period.
5. Code Approval:
 - a. All computer based electronic equipment shall conform to the requirements of FCC regulation Part 15, subpart J, for Class A computing devices governing radio frequency electromagnetic interference (EMI).
 - b. All wiring shall be in accordance with Article 760, 725 and 800 of the National Electric Code.
 - c. System devices and components shall be designed and tested per MIL Standard 462, 462B and 461B to withstand both conducted and radiated electromagnetic interface while continuing to operate normally.
 - d. All equipment and components shall be designed and tested to assure compliance with FCC Part 15, Section 15 for conducted and radiated emissions and shall be so labeled.
6. The specification covers minimum requirements and are not intended to preclude provision of equipment or methods that exceed the requirement.

B. Performance Tests:

1. Perform pretests and tests in accordance with paragraph, TESTS, in Section 01 01 00, GENERAL REQUIREMENTS, and in accordance with Test Plans and Specifications. Submit Test Report including Final Operational Test.
2. Demonstrate to the Project Engineer that all controls are installed, adjusted, and can perform all functions required by the contract drawings and specifications. When coordinated with the Project Engineer demonstration may be performed in conjunction with instructions to VA operations personnel.
3. Final Operational Tests:
 - a. Performance Test Period: Not less than 168 consecutive hours to demonstrate proper functioning of the complete ECC system. Continue test on a day to day basis until the performance standard is met.

- b. Acceptance Performance Standard: Operation at an average effectiveness level (AEL) of at least 95 percent for the performance test period. Whenever downtime occurs correct defects before resuming test. Failure due to an individual sensor or controller shall not count as system downtime provided that:
 - 1) The system records the fault.
 - 2) The AEL for all sensors and controllers together is at least 95 percent of the test period.
- C. Equipment Identification: Section 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS.
- B. Manufacturer's literature and data for all components including the following:
 - 1. One-line schematics of wiring of sensors and actuators to DCP cabinets.
 - 2. Schematic of all termination points within each cabinet.
 - 3. Control valves schedule.
 - 4. Catalog cut sheets of all equipment used. This includes, but is not limited to DDC panels, peripherals, sensors, actuators, etc.
 - 6. Proof of availability of specified standard/tested DDC control program submodules.
 - 7. Flow charts for each sequence of operation.
 - 8. Define a preliminary scope and sequence of field tests that will be executed to demonstrate that the system performs all specified functions. Include in the scope the method by which system accuracy will be demonstrated.
- C. Certificates:
 - 1. Compliance with paragraph, QUALITY ASSURANCE.
 - 2. The supplier shall have a minimum of three years experience in the design and installation of computerized building systems similar in performance to that specified herein. 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 to be involved with the supervision, the engineering, and the installation of the system. Information concerning the amount of training and experience shall be included in each resume. Personnel information failing to disclose at least a three year experience record will be grounds for disqualification of the supplier.
- D. Operation and Maintenance Manuals:
 - 1. Submit in accordance with paragraph, INSTRUCTIONS, in Section 01010, GENERAL REQUIREMENTS.

2. Include the following documentation:

- a. General description and specifications for all components.
- b. Detailed illustrations and complete calibration procedures.
- c. One copy of the final version of all software.
- d. Complete trouble-shooting procedures and guidelines.
- e. Complete operating instructions for all systems.
- f. Maintenance Instruction: Document all maintenance and repair/replacement procedures. Replacement procedures shall be documented down to the board level. Provide ordering number for each system component, and source of supply. Provide a list of recommended spare parts needed to minimize downtime.

1.5 INSTRUCTIONS

A. Instructions to VA operations personnel: Perform in accordance with paragraph, INSTRUCTIONS, in Section 01 01 00, GENERAL REQUIREMENTS.

1. First phase: Formal instruction, for a total of 8 hours, conducted prior to the performance test period, at a time mutually agreeable to the Contractor and the Project Engineer.
2. Second phase: On the job training during start-up, check-out, and performance test period. On the job training shall consist of facilities personnel working with the Contractor's installation and test personnel on a daily basis. During the performance test period, provide one 8-hour period of instruction.
3. The O/M Manuals shall contain approved submittals as outlined in SUBMITTALS paragraph 1.4. In addition, provide diagrammatic layouts of the DDC systems specified herein. The layouts shall show all DDC cabinets, all connected mechanical systems, location and function of each sensor, actuator, and equipment cut sheets of the entire system. O/M Manual shall contain a detailed description of the systems and a complete listing of all software programs required to perform the sequence of operation. O/M Manual shall describe all commands, operating and trouble shooting instructions, and routine maintenance procedures to be used with the systems.
4. Training by independent or franchised dealers who are not direct employees of the temperature control company will not be acceptable.

1.6 JOB CONDITIONS

Environmental Conditions of Operation:

A. Remote equipment:

1. The DCP's and all associated equipment shall be designed to operate in ambient conditions of 35 to 120 degrees F at a relative humidity of 0 to 95 percent non-condensing.
2. Sensors and controlling devices shall be designed to operate in the environment which they are sensing or controlling but not less severe than for DCP's.

1.7 APPLICABLE PUBLICATIONS

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

A. Federal Specifications (Fed. Spec.):

GG-T-321D(2).....Thermometers, Self-Indication, Liquid-in-glass for Machinery and Piping Systems

B. American National Standards Institute (ANSI):

B16.22-80.....Wrought Copper and Copper Alloys - Solder Joint Pressure Fittings

B19.3-86.....Safety Standard for Compressors for Process Industries

C. American Society of Mechanical Engineers (ASME): Section 8-D-1-86, Pressure Vessels, Division 1

D. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
1987 Systems Handbook

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

B88-86.....Seamless Copper Water Tube

B280-83.....Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

B486-74.....Paste Solder

D635-81.....Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

D1693-70.....Environmental Stress-Cracking of Ethylene Plastics

F. Instrument Society of America (ISA):

57.3-75.....Quality Standard for Instrument Air (R1981)

G. National Fire Protection Association (NFPA):

70-87.....National Electrical Code

90A-85.....Installation of Air Conditioning and Ventilating Systems

H. Scientific Apparatus Makers Association (SAMA): Standard

PMC20.1-1973.....Process Measurement and Control Terminology

I. Underwriters Laboratories (UL):

UL 94-80.....Test for Flammability of Plastic Materials for Parts in Devices and Appliances

PART 2 - PRODUCTS

2.1 THERMOSTATS

- A. Room thermostats controlling heating and cooling devices shall have three modes of operation (heating - null or dead band - cooling). Wall mounted thermostats shall have backing plate, setpoint and temperature display and external adjustment. Space sensors shall be equipped with in-space User set-point adjustment, override switch, numerical temperature display on sensor cover, and communication port.

1. Electronic Thermostats:

- a. Room Thermostats: Provide a platinum space temperature sensor with setpoint adjustment and a setpoint indicator.

- 2.2 Humidity Sensors:** Bulk polymer sensing element type, corrosion and vibration resistant. For operating room application, a combination thermostat-humidistat shall be fully integrated with the room supply and return venture air valves with built-in controller on each valves. Operating conditions in each of the operating rooms shall be displayed on a monitoring panel. This panel shall be compatible (BACnet protocol) with building EMS and shall communicate with room level system controllers.

- 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.

2.3 FINAL CONTROL ELEMENTS AND OPERATORS

- A. Fail Safe Operation: Design and install control valves to "fail safe" in either the normally open or normally closed position.
- B. Spring Ranges: Provide range as required for system sequencing and to provide tight close-off.
- C. Control Valves:
1. Valves shall be electric.
2. 2-inch and smaller valves shall be bronze body with screwed or flare connections.
3. Provide brass or bronze seats except for valves controlling media above 210 degrees F, which shall have stainless steel seats.
4. Flow characteristics:

- a. Three way valves shall have a linear relation or equal percentage relation of flow versus valve position.
- b. Two-way valves position versus flow relation shall be equal percentage for water flow control.

5. Maximum pressure drop through valve:

- a. Modulating water flow control: Greater of 10 feet of water or the pressure drop through the apparatus.
- b. Two position water valves shall be line size.

D. Valve Operators and Relays:

- 1. Operators shall be electronic.
- 2. Relays shall be of the following type:
 - a. Electrical interlocking relays.
 - c. Electrical pilot duty or contactor types: Provide inductive rated contacts for circuits with coils, motors or other inductive devices.

2.4 DIRECT DIGITAL CONTROL SYSTEM HARDWARE

A. To prevent a single-failure catastrophe, and to minimize the effect of a controller failure, multiple digital controllers (CU's) shall be provided. Failure of any single controller shall have no effect on other controllers.

- 1. Separate controllers shall be provided where indicated on drawings as minimum requirements (at least one CU per air handling unit. Additional CUs may be provided at Contractor's option.

B. Direct digital controllers (CUs) shall be microprocessor-based with all hardware, software, and communications interfaces. In normal operating mode, CUs shall communicate with one another and with the ECC. If communication with other CUs or the ECC is interrupted the CUs shall continue to operate in a standalone mode. The controllers shall each be either 16 bit, or multiple 8 bit microprocessors configured in a true distributed manner where input-output processing is a function of the DDC controller.

- 1. The controller shall be factory mounted and wired in a steel enclosed Distributed Control Panel (DCP) complete with all relays, digital to analog converters, and terminal strips. Controllers shall be capable of a minimum of 8 to 10 analog inputs, 8 to 10 true analog outputs, 8 to 10 digital inputs, and 8 to 10 digital outputs, and shall be expandable to at least 16 of each type (analog and digital input and output) within the DCP.
- 2. The controllers and I/O function boards shall be designed to operate in the following environmental ambient conditions:
 - a. Temperature: 32 degrees F to 120 degrees F
 - b. Humidity: 0 to 95 percent RH (non-condensing)

c. Voltage fluctuation of +10% to -15% volts at 60 Hz and shall withstand storage conditions as follows:

- 1) Temperature: Minus 4 degrees F to 176 degrees F
- 2) Humidity: Zero to 95 percent RH (non-condensing)

3. The system shall utilize PROM and RAM memory. All DDC algorithms and parameters shall be RAM based for ready access for modification and adjustment. RAM memory shall be provided with 72 hours battery backup minimum.

C. Input/Output Equipment:

1. Input/Output (I/O) modules shall accept industrial platinum resistance sensors. Analog input resolution shall be 12 bit; 8 bit resolution controllers are not acceptable. Each output point shall be provided with a light emitting diode (LED) which shall indicate status (on-off) of digital outputs and value via variable intensity of analog outputs. Analog outputs must be true analog for proportional output control. In lieu of LEDs, individual two inch analog or one inch digital display indicators shall be provided for each analog output. Processor software shall allow for scaling and for calibration of sensor lead length variations to insure display accuracies.

2. The following table indicates the type of sensors and signal levels that shall be used for input/output to the direct digital controllers. Reference the HARDWARE section of these specifications for further sensor requirements. Thermistor or thermocouple inputs are not acceptable.

SENSOR/OUTPUT DEVICE	SENSOR RANGE
RTDs w/Transmitters	4-20 ma, 0-10VDC
Platinum Element Direct	1000 or 3000 ohm
RTD or Balco Direct	500 or 1000 ohm
E/P Output Transducer	3-15 PSI
Pressure	4-20 ma, 0-10V, 0-1V
Others-i.e., Current, Voltage	4-20 ma, 0-10V

3. The CUs and digital output modules shall be capable of performing two and three state output functions to emulate H-O-A switches, contact closures, etc.

D. UL Listing: The Control Unit (CU) shall be listed by Underwriters Laboratories for energy management per UL 916 standards.

E. Diagnostic Devices (DD):

1. Each Control Unit (CU) shall be supplied with connections to which maintenance personnel can connect portable diagnostic operators terminals (PDOT's) and portable programming terminal (PPT) for data display, setpoint modification, etc., and reloading and/or modification of controller programs.

F. Spare Equipment:

1. Provide spare control unit (CU) boards and spare input/output (I/O) boards with minimum 15% each for analog and digital points. It shall be possible for trained hospital personnel to replace CU boards and

load software via the PPT and/or the Engineering Control Center (ECC).

- a. Provide two (2) spare control unit boards. If power supplies are separate, supply separate power supplies and other parts to make at least two complete sets of DC control equipment spares.
- b. If input/output (I/O) boards are separate from the CU boards, provide four spare I/O boards for each spare CU board provided above.

2.5 DIRECT DIGITAL CONTROLLER SOFTWARE

- A. The DDC system shall be a network of independent standalone control units (CU). Each CU shall be capable of full control as a completely independent unit. The CUs shall include standalone capability of direct digital control with integrated energy management programs including duty cycling, time scheduling, optimum start and stop and load reset programs.
 1. The CU operating system software shall be PROM resident and operate independently of the ECC. The operating system shall provide alarm monitoring and reporting, provide control application packages, and contain built-in automatic diagnostic routines.
 2. Each CU shall contain self-diagnostics that continuously monitor the integrity of the system. Any malfunction of the system will be reported to the ECC to inform the operator of the nature of the malfunction of the CU's affected. The controllers shall have memory error checking. Upon detection of a memory error, the CU shall correct the error or halt to prevent erroneous operation. All halts shall be reported to the ECC.
 3. After a power failure and upon a power restoration, the system shall provide automatic sequential restart of equipment based on current program time and program requirements without operator invention.
- B. All temperature control functions shall execute within the standalone 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. Each CU shall include the following standalone functions:
 1. Direct Digital Control algorithms and control sequences are to be CU resident and be capable of standalone operation independent of the ECC. All DDC programs shall be custom written as required to meet the performance criteria spelled out in the sequence of operation paragraphs for each controlled mechanical system. PID algorithm shall be employed as appropriate to the application and per sequences or operation.
 2. All CU resident DDC programs shall be capable of being enabled or disabled from the ECC. In the enable mode all DDC loops shall be active and output signals shall be routed to the final control elements. In the disable mode all DDC loop calculations shall continue but outputs to actuators shall be suppressed. (When disabled, control outputs shall stay in the same state or position as commanded from the central or until they are manually set to automatic.)
 3. To eliminate integral windup, all PID programs shall automatically invoke integral windup prevention routines whenever the controlled unit is

off, under manual control or under control of an EMS or time initiated program.

C. Default Value Operation:

1. All CU's 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, 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 central control and command station. Each CU shall have capability for local readouts of all functions.

D. Control loops shall be able to utilize any of the following control modes:

1. Two position (on-off, slow-fast, etc.)
2. Proportional
3. Proportional plus integral (PI)
4. Proportional plus integral plus derivative (PID)

E. Standard/Tested DDC Control Program Submodules:

1. The following list is typical of standard direct digital control submodules that have been written, factory tested and successfully used on many projects. Proof shall be included in the submittal that such project applicable programs standard have be written, tested and successfully used by the contractor on at least five other projects.
 - a. Sequenceable analog output submodule
 - b. Sequenceable two-position output submodule
 - c. Reset main temperature setpoint submodule
 - d. Single zone control submodule
 - e. Highest of two sensors control submodule
 - f. Three input controller submodule
 - g. Fan static pressure control submodule
 - h. Differential temperature control submodule
 - i. Binary step output submodule
 - j. Step and proportional output submodule
 - k. Single zone control with heating/cooling submodule
 - l. Single input control with EMCS submodule flow charts
2. Provide flow charts for each of the project submodule programs at time of submittal.

F. System Diagnostics:

1. Diagnostic software and hardware diagnostic software stored in non-volatile memory shall be provided for the central computer and each remote DCP (CU). Each board within each remote DCP shall independently execute its own cold-start initialization diagnostic routines. These tests shall assure that the board circuitry is operating properly and that the individual boards within the system communicate with each other properly. If any test within the system detects a problem, a message shall be output to the peripheral devices provided the failure is not within the peripheral devices themselves or within the peripheral communication circuitry. Additionally, LED indicators which are visible while the board is operating shall be provided to localize the fault. The LED indicators shall operate in addition to the peripheral device reporting.
2. Cold-start initialization diagnostics shall be initiated by power-up and operator keyboard request. Additional hardware and software shall be provided to continuously monitor on-line system operation and detect system faults.
3. Central computer diagnostics (RAM Tests): A battery of RAM diagnostics shall run upon cold-start initialization which will detect single bit, adjacent bit and column address failures. Detection of a failure shall cause an error message output to the peripheral devices.

G. Application Software:

1. All application software programs, except for power demand, shall be distributed throughout the CU's in the system. Distributed software resident in CU's shall be provided for stand-alone operation independent of the existing ECC and to improve system throughput and response time by reducing the workload on the central control. All CU's shall contain O.S. software for scheduling and controlling resident programs, and for data file management. All energy management sensor failures shall be immediately reported to the operator. Each unique application program shall be capable of being enabled or disabled by the operator from the ECC. If the CU's cannot provide the application software this capability must be supplied in the ECC.
2. Provide the following programs as a minimum:
 - a. Event initiated programs (EIP): The system shall provide for a minimum of 200 event initiated programs. Event initiators may be any digital data point in the system, real time values, or any analog alarm limit. The EIPs shall be structured so that one initiator may set and reset the EIP as it goes from normal to off-normal and back to normal, or one initiator may set the program and a second initiator reset the program, or reset may be manual via the console keyboard. Setting an EIP shall cause a series of start or stop commands to assigned loads to be executed to EIP points. EIPS shall have priority assignments to allow them to override other programs in the set mode when desired. The operator's terminal shall have read-write capability for initiator load and priority assignment.

- b. Automatic restart programming: Motor in "start" mode shall not restart instantaneously when power is restored after failure. Restart shall be sequenced by the ECC restart program.
 - 1) Automatic restart of preassigned field equipment upon resumption of commercial power: Provide a computer software program that will restart field devices in preassigned sequence upon restoration of commercial power. The program shall execute the appropriate sequential commands to restore the building to a minimal, satisfactory operating condition. The operator shall be able to assign equipment to be started, on-line, through the keyboard. Indication of commercial power return as well as program initiation shall be displayed and recorded at the printer.
 - 2) Automatic restart of preassigned field equipment upon application of emergency power: Provide a computer software program that will restart field devices upon application of emergency and commercial power resumption, and shall execute the appropriate sequential minimal, satisfactory operating condition under emergency power conditions. The operator shall be able to assign equipment to be started, on-line through the keyboard.
 - 3) Indication of commercial power failure and emergency power as well as program availability initiation shall be displayed and recorded at the printer. All field cabinet (DCP) power failures shall be printed. A status message shall be printed whenever emergency or commercial power is restored. A hold interval shall be provided before program channel initiation to allow operator intervention.
- c. Preventative maintenance instruction (PMI) programming: A preventative maintenance alarm shall be printed indicating maintenance requirements based on run time. The log shall include all equipment listed in the ECC schedule that have reached limit criteria of calendar-date (month-day-year) or high accumulation of totalized run-time (for points with start/stop or run status indication). Each PMI message shall include point descriptions, limit criteria and preventative maintenance instruction assigned to that limit. PMI shall be provided for each component of units such as air handling units. All limit criteria, PMI and reset-to-zero assignments shall be operator programmable, on-line at the keyboard. Stagger initial alarms to distribute maintenance throughout the year. Program initial PM alarms as follows:
 - 1) Air handling units: 2000 hours run time.
 - 2) Prefilters: 1000 hours run time
- d. Fire emergency programming.

H. Sensor and Control Devices:

- 1. General: Provide all remote sensing points and instrumentation as required for the systems. All sensors shall have accuracies as stated hereinafter.
- 2. Field wiring for each digital device shall be two or three conductor No. 18 AWG, or larger twisted sets of copper conductors 300 volts, thermoplastic. When line voltage is present in conduits or wiring trays the insulation on all conductors shall be 600 volts. For

multiconductor wire having four or more conductors, wire size shall be not less than No. 20 AWG solid copper.

3. Temperature Sensors:

- a. Temperature sensors shall be of the resistance type. Thermo-couples may be used but shall be restricted to temperature range of 500 degrees F and above.
- b. The following shall apply to temperature sensors:
 - 1) Stem or tip sensitive types.
 - 2) Sensing elements shall be hermetically sealed.
 - 3) Stem and tip construction shall be 304 stainless steel, copper, glass or epoxy.
 - 4) All external trim material shall be corrosion resistant designed for the intended application.
 - 5) Thermometer wells shall be of bronze, stainless steel, copper, or monel materials. Heat transfer compounds shall be compatible with the sensors. At each sensor location in piping provide a well suitable for a glass stem mercury thermometer.
 - 6) Sensor accuracy: Sensors are only one element in the overall system accuracy to which the CU can respond. That response includes alarm decision, value display, value calculation on which analog values must be multiplied, subtracted, square rooted, etc. As such, the system end-to-end accuracies are herein stated. Sensors that have a tendency to drift with age shall be supplied with self-correcting circuits. Accuracy requirements also vary with application, therefore the following range/accuracies are stated:

Typical Range	Accuracy	Typical Application
30 to 70 deg. F	plus or minus 0.5 deg. F	Chilled Water
Minus 50 to 100 deg.F	plus or minus 1.2 deg. F	O.A.
0 to 100 deg. F	plus or minus 0.7 deg. F	Space Temps
50 to 250 deg. F	plus or minus 1.2 deg. F	General Equip
Sensors for differential temperature readings to be used in BTU calculations shall be a matched pair with a differential accuracy of plus or minus 0.1 degrees F.		

4. Differential pressure sensors:

- a. The entire assembly shall be constructed so shock, vibration and pressure surges of 25 psi above scale will neither harm the gauge nor affect its accuracy.
- b. Sensors shall have the following features:
 - 1) Adjustable high and low limits.
 - 2) Suitability for operation in an ambient temperature range of 30-140 degrees F.
 - 3) Accuracy within 5 percent of full scale.

- c. Flow status of fans, shall be proven by differential pressure switches. Provide software resident time delays to prevent false alarms during starting/stopping including printout and application programs.

5. Pressure differential switches:

- a. All pressure sensing elements shall be corrosion resistant.
- b. Pressure sensing elements shall be Bourdon tubes, bellows diaphragm or piezoelectric type.
- c. Switch type units shall have adjustable set point settings.
- d. Pressure sensor switches shall be snap action type contacts designed for the application. For logic inputs to the FID condenser for the application. For logic inputs to the FID contacts shall be short radius gold or rhodium plated to insure proper switching for the power logic circuits. When switching other items they shall be suitable for the load.
- e. Switch type sensor assemblies shall operate automatically and reset automatically when conditions return to normal.
- f. Sensor ratings: Sensors shall have the following pressure and accuracy ratings.

- 1) Chilled and hot water sensors shall be rated at 125 psig.

2.6 SYSTEM SIGNAL TRANSMISSION

- A. General: All CU input signal circuits shall be in metal conduit or in approved shielded cable or both. All network communications between CUs and from CUs to the ECC must be installed in metal conduit.
 - 1. Communications between direct digital controllers (CUs) shall be RS422 or 600 baud minimum with a system line capability of at least 3300 feet, or RS232C with modems.
 - 2. Transmission line shall be electrically isolated from the CUs and the ECC by optical couplers at each interface to prevent any voltages in the transmission lines from damaging any of the electronic circuits.
 - 3. Lightning protection: All cables entering or exiting a building which serve as communication links (DCP to ECC or between DCPs) shall have lightning arrestor networks installed near the point where the cable penetrates the building. Both primary detection devices (such as a three electrode gas type surge arrestor or equal) and secondary protectors shall be installed as a minimum and shall be as required to reduce dangerous voltages to nondamage levels. Fuses are not permitted as communication line lightning protection devices. Suitable forms are zener diodes, optical isolation, varistors and combinations of these with the proper interconnection circuitry. Transient protection shall protect against spikes up to 1000 volts peak voltage with a one microsecond delay time. The protective device shall be automatic, self restarting, and on duty at all times. Circuit design and protective devices shall be selected assuming a maximum of 25 ohms grounding condition.

4. All transmission bus connected devices, DCPs, etc., shall be such that loss of any single device shall not disrupt or interfere with communication to other devices on the bus. Loss of communication with the ECC shall not cause any DCP to halt operation or to cease to perform its intended function (i.e., each DCP shall continue to operate on a stand-alone basis).

B. Intercomputer Communication:

1. Intercomputer communication shall support true global control strategies as well as allow data status and values connected to one DCP to be used within application programs of another DCP.
2. The system shall provide a network communication facility to support global calculation and control strategies to be continuously implemented in the distributed system. The system shall provide for events detected in any area of the total network to initiate commands to any other device within the network. The system shall also provide for connection of calculated data to be continuously shared between any or all controllers within the total network.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Workmanship: Provide skilled technicians, properly trained and qualified for the work and directed by experienced engineers. Only JC Metasys certified engineers and technicians are allowed to carry out the work and ensure that seamless communication and interface with the existing system will be achieved.
2. Work coordination: Section, GENERAL CONDITIONS.
3. Electrical work and safety requirements: NFPA 70 and ANSI C2, and referenced electrical sections of these specifications.
4. Wiring: The term wiring is construed to include furnishing of wire, conduit, miscellaneous material and labor to install a working system. Outdoor installations shall be of weatherproof construction or in NEMA 3R or 4 enclosures.
5. Welding and piping: Perform in accordance with industry standards.
6. Except for short apparatus connections, run conduit parallel to or at right angles to the building structure. Conceal conduit in finished spaces.
7. Do not run conduit concealed under insulation or inside ducts. Mount control devices, conduit located on ducts or apparatus with external insulation on stand-off support to avoid interference with insulation.
8. Run wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing. Rack connections bridging a cabinet door along the hinge side and protect from damage. Provide grommets, sleeves or vinyl tape to protect or wires from sharp edges of panels, conduit, and other items.

9. Equipment and materials identification: Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL).

B. Field Materials:

1. Sensors and controls:

- a. Provide all remote sensors and instrumentation.
- b. 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.
- c. Label or code each field wire at each end. 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.
- d. Temperature sensors:
 - 1) Temperature sensors shall be readily accessible and adaptable to each type of application in such a manner as to permit for quick, easy replacement and servicing without special tools or skills.
 - 2) Mount duct sensors in locations to sense the correct temperature of the air only, within the vibration and velocity limits of the sensing element. Mount extended surface element, when used, securely within the duct and position to measure the best average temperature. Thermally isolate elements from brackets and supports to respond to air temperature only. Securely seal duct penetrations.

2. DCPs: Install in accordance with manufacturer's published instructions and requirements.

C. Signal Transmission System Equipment:

1. General: Install all system components in accordance with the National Electrical Code and the manufacturer's recommendations; fuse and ground them properly.
 - 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 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:
 - 1) Keep cable runs as short as possible. Allow extra length for connecting to the terminal board.
 - 2) Do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter.

- 3) Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.

2. Grounding:

- a. Ground system per manufacturer's requirements for proper and safe operation.

3.2 FIELD TEST AND INSPECTIONS

- A. System Equipment: Upon completion of installation of each piece of equipment, field inspect and mechanically and electrically test equipment for proper function.
- B. Field Materials: Upon completion of installation of each piece of equipment, field inspect and mechanically and electrically test equipment for proper function.
- C. Signal Transmission System Equipment:
 1. Ground rod tests: Before any wire is connected to the ground rods, use a portable ground testing instrument to test each ground or group of grounds.
 2. Coaxial cable tests: Implement NEMA Standard Publication WC41 as a minimum.
- D. Software Demonstration: Perform tests as required in Part 1.
- E. Performance Tests: Perform in accordance with Article, QUALITY ASSURANCE, PART 1, Paragraph 1.3.
- F. Instructions: Article, INSTRUCTIONS, PART 1, Paragraph 1.5.

- - - E N D - - -

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The control system(s) shall be as indicated on the project documents, point list, drawings and described in these specifications. This scope of work shall include a complete and working system including all engineering, programming, controls and installation materials, installation labor, commissioning and start-up, training, final project documentation and warranty.
- B. Connect the new work to the existing Johnson (Metysis) central ECC system located in Building. New system including interface to existing systems and equipment 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. The existing CPU/CRT, printer and other peripherals may be used to form a single central control center. Modify the existing ECC, if necessary, to accommodate the additional control points.
- C. The Controls Contractor's work 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 by the Contract for the complete and fully functional Controls Systems.
- D. Following control devices and systems shall be used to provide the functional requirements of HVAC equipment and systems.
 - 1. Direct Digital Control (DDC) of HVAC equipment and systems with electric or electronic positioning of valves and dampers.
 - 2. Terminal units including VAV Boxes, Fan Coil Units and similar units for control of room environment conditions may be equipped with

integral controls furnished and installed by the equipment manufacturer or field mounted. Refer to equipment specifications and as indicated in project documents.

- E. The control subcontractor shall supply as required, all necessary hardware equipment and software packages to interface between any existing and new system controllers as part of this contract.
- F. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. Temperature Controls contractor 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.

1.2 RELATED WORK

- A. Section 28 31 00, FIRE DETECTION AND ALARM.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- C. Section 23 21 13, HYDRONIC PIPING and Section 23 22 13.
- D. Section 23 36 00, AIR TERMINAL UNITS.
- E. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.
- F. Section 23 74 13, PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS.
- G. Section 23 31 00, HVAC DUCTS AND CASINGS.
- H. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- I. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- J. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- K. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- L. Section 26 27 26, WIRING DEVICES.

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. ACU: Auxiliary Control Unit (ACU) used for controls of air handling units, reports to RCU.
- C. Analog: A continuously varying signal value (e.g., temperature, current, velocity etc.

- D. BACnet: Building Automation Control Network Protocol, ASHRAE Standard 135.
- E. 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).
- F. 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.
- G. 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.
- H. Bus Topology: A network topology that physically interconnects workstations and network devices in parallel on a network segment.
- I. 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. In this specification, there are three types of control units are used; Unitary Control Unit (UCU), Auxiliary Control Unit (ACU), and Remote Control Unit (RCU).
- J. 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).
- K. 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.
- L. 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.
- M. 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.

- N. 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.
- O. DXF: An AutoCAD 2-D graphics file format. Many CAD systems import and export the DXF format for graphics interchange.
- P. 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.
- Q. 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.
- R. 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.
- S. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.
- T. Firmware: Firmware is software programmed into read only memory (ROM) chips. Software may not be changed without physically altering the chip.
- U. FTT-10: Echelon Transmitter-Free Topology Transceiver.
- V. GIF: Abbreviation of Graphic interchange format.
- W. 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.
- X. Graphic Sequence of Operation: It is a graphical representation of the sequence of operation, showing all inputs and output logical blocks.
- Y. 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.
- Z. I/P: Internet Protocol-global network, connecting workstations and other host computers, servers etc. to share the information.
- AA. JPEG: A standardized image compression mechanism stands for Joint Photographic Experts Group, the original name of the committee that wrote the standard.
- BB. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.
- CC. LonMark: An association comprising of suppliers and installers of LonTalk products. The Association provides guidelines for the implementation of the LonTalk protocol to ensure interoperability through Standard implementation.
- DD. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a "Neuron Chip" for communication.
- EE. LonWorks: Network technology developed by the Echelon Corporation.
- FF. Network: A set of computers or other digital devices communicating with each other over a medium such as wire, coax, fiber optics cable etc.
- GG. Network Area Controller: Digital controller, supports a family of auxiliary control units and unitary control units, and communicates with peer-to-peer network for transmission of global data.
- HH. Network Repeater: A device that receives data packet from one network and rebroadcasts to another network. No routing information is added to the protocol.
- II. MS/TP: Master-slave/token-passing.
- JJ. Operating system (OS): Software, which controls the execution of computer application programs.
- KK. 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.
- LL. Peripheral: Different components that make the control system function as one unit. Peripherals include monitor, printer, and I/O unit.
- MM. Peer-to-Peer: A networking architecture that treats all network stations as equal partners.
- NN. PICS: Protocol Implementation Conformance Statement.

OO. UCU: Unitary Control Unit, digital controller, dedicated to a specific piece of equipment, such as VAV boxes, chillers, fan coil units, heat exchangers etc.

1.4 QUALITY ASSURANCE

A. Criteria:

1. The Controls and Instrumentation System Contractor shall be a primary equipment manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Facility Management Systems of similar size, scope and complexity to the EEC specified in this Contract. Distributors, manufacturer's representatives and wholesalers will not be acceptable.
2. Single Source Responsibility of subcontractor: The Contractor shall obtain hardware and software supplied under this Section and delegates 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.
3. 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.
4. 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.
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. 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.
 7. 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.
3. Peer-to-peer controllers, unitary controllers shall conform to the requirements of UL 916, Category PAZX.

1.5 PERFORMANCE

A. The system shall conform to the following:

1. Graphic Display: The system shall display up to 4 graphics on a single screen with a minimum of (20) dynamic points per graphic. All current data shall be displayed within (10) seconds of the request.
2. Graphic Refresh: The system shall update all dynamic points with current data within (10) 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 (10) seconds. Analog objects shall start to adjust within (3) 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 (10) 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. Performance: Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every five (5) seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Multiple Alarm Annunciations: All workstations on the network shall receive alarms within (5) seconds of each other.
9. Reporting Accuracy: Listed below are minimum acceptable reporting accuracies for all values reported by the specified system:

Measured Variable	Reported Accuracy
Space temperature	±0.5 degrees C (±1 degrees F)
Ducted air temperature	±1.0 degrees C [±2 degrees F]
Outdoor air temperature	±1.0 degrees C [±2 degrees F]
Water temperature	±0.5 degrees C [±1 degrees F]
Relative humidity	±2 percent RH
Water flow	±5 percent of full scale
Air flow (terminal)	±10 percent of reading
Air flow (measuring stations)	±5 percent of reading
Air pressure (ducts)	±25 Pa [±0.1 "W.G.]
Air pressure (space)	±3 Pa [±0.001 "W.G.]
Water pressure	±2 percent of full scale *Note 1
Electrical Power	5 percent of reading

Note 1: for both absolute and differential pressure

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. 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. Installation instructions for smoke dampers and combination smoke/fire dampers, if furnished.
 5. Control air-supply components, and computations for sizing compressors, receivers and main air-piping, if pneumatic controls are furnished.
 6. Catalog cut sheets of all equipment used. This includes, but is not limited to 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.

7. Sequence of operations for each HVAC system and the associated control diagrams. Equipment and control labels shall correspond to those shown on the drawings.
8. Color prints of proposed graphics with a list of points for display.
9. Furnish PICS for each BACNET compliant device.

C. Product Certificates: Compliance with Article, QUALITY ASSURANCE.

D. 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.

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

1. Submit in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS.
2. Include the following documentation:
 - a. General description and specifications for all components, including logging on/off, alarm handling, producing trend reports, overriding computer control, and changing set points and other variables.
 - b. Detailed illustrations of all the control systems specified for ease of maintenance and repair/replacement procedures, and complete calibration procedures.
 - 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. Licenses, guaranty, and other pertaining documents for all equipment and systems.
 - h. 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.
- F. 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. First Phase: Formal instructions to the VA facilities personnel for a total of 16 hours, conducted sometime between the completed installation and prior to the performance test period of the control system, at a time mutually agreeable to the Contractor and the VA.
 - 2. Second Phase: This phase of training shall comprise of on the job training during start-up, checkout period, and performance test period. VA facilities personnel will work with the Contractor's installation and test personnel on a daily basis during start-up and checkout period. During the performance test period, controls subcontractor will provide 8 hours of instructions to the VA facilities personnel.
 - 3. The O/M Manuals shall contain approved submittals as outlined in Article 1.7, SUBMITTALS. The Controls subcontractor will review the manual contents with VA facilities personnel during second phase of training.
 - 4. Training by independent or franchised dealers who are not direct employees of the controls supplier will not be acceptable.

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 65 to 90 degrees F at a relative humidity of 20 to 80 percent non-condensing.

- B. The CUs and associated equipment used in controlled environment shall be mounted in NEMA 1 enclosures for operation at 32 to 122 degrees F at a relative humidity of 10 to 90 percent non-condensing.
- C. The CUs used outdoors shall be mounted in NEMA 4 waterproof enclosures, and shall be rated for operation at -40 to 150 degrees F.
- D. All electronic equipment shall operate properly with power fluctuations of plus 10 percent to minus 15 percent of nominal supply voltage.
- E. 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 135-04.....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.
 - BPVC-CC-N-04.....Boiler and Pressure Vessel Code
- D. American Society of Testing Materials (ASTM):
 - B32-04.....Standard Specification for Solder Metal
 - B88-03.....Standard Specifications for Seamless Copper Water Tube
 - B88M-05.....Standard Specification for Seamless Copper Water Tube (Metric)
 - B280-03.....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):

802.3-05.....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. Instrument Society of America (ISA):

7.0.01-1996.....Quality Standard for Instrument Air

H. National Fire Protection Association (NFPA):

70-05.....National Electric Code

90A-02.....Standard for Installation of Air-Conditioning
and Ventilation Systems

I. Underwriter Laboratories Inc (UL):

94-06.....Tests for Flammability of Plastic Materials for
Parts and Devices and Appliances

294-05.....Access Control System Units

486A/486B-04-.....Wire Connectors

555S-03.....Standard for Smoke Dampers

916-Rev 2-04.....Energy Management Equipment

1076-05.....Proprietary Burglar Alarm Units and Systems

PART 2 - PRODUCTS

2.1 THERMOSTATS

A. Room thermostats controlling heating and cooling devices shall have three modes of operation (heating - null or dead band - cooling). Wall mounted thermostats shall have backing plate, setpoint and temperature display and external adjustment.

1. Electronic Thermostats:

- a. Laboratory Room Thermostats: Provide a platinum space temperature sensor with setpoint adjustment and a setpoint indicator.

2.2 FINAL CONTROL ELEMENTS AND OPERATORS

A. Fail Safe Operation: Design and install control valves to "fail safe" in either the normally open or normally closed position.

B. Spring Ranges: Provide range as required for system sequencing and to provide tight close-off.

C. Control Valves:

1. Valves shall be electric.

2. 2-inch and smaller valves shall be bronze body with screwed or flare connections.
 3. Provide brass or bronze seats except for valves controlling media above 210 degrees F, which shall have stainless steel seats.
 4. Flow characteristics:
 - a. Three way valves shall have a linear relation or equal percentage relation of flow versus valve position.
 - b. Two-way valves position versus flow relation shall be equal percentage for water flow control.
 5. Maximum pressure drop through valve:
 - a. Modulating water flow control: Greater of 10 feet of water or the pressure drop through the apparatus.
 - b. Two position water valves shall be line size.
- D. Valve Operators and Relays:
1. Pneumatic operators shall be electric.
 2. Relays shall be of the following type:
 - a. Electrical interlocking relays.
 - b. Electrical pilot duty or contactor types: Provide inductive rated contacts for circuits with coils, motors or other inductive devices.

2.3 DIRECT DIGITAL CONTROL SYSTEM HARDWARE

- A. To prevent a single-failure catastrophe, and to minimize the effect of a controller failure, multiple digital controllers (CU's) shall be provided. Failure of any single controller shall have no effect on other controllers.
1. Separate controllers shall be provided where indicated on drawings as minimum requirements (at least one CU per air handling unit. Additional CUs may be provided at Contractor's option.
- B. Direct digital controllers (CUs) shall be microprocessor-based with all hardware, software, and communications interfaces. In normal operating mode, CUs shall communicate with one another and with the ECC. If communication with other CUs or the ECC is interrupted the CUs shall continue to operate in a standalone mode. The controllers shall each be either 16 bit, or multiple 8 bit microprocessors configured in a true distributed manner where input-output processing is a function of the DDC controller.
1. The controller shall be factory mounted and wired in a steel enclosed Distributed Control Panel (DCP) complete with all relays, digital to analog converters, and terminal strips. Controllers

- shall be capable of a minimum of 8 to 10 analog inputs, 8 to 10 true analog outputs, 8 to 10 digital inputs, and 8 to 10 digital outputs, and shall be expandable to at least 16 of each type (analog and digital input and output) within the DCP.
2. The controllers and I/O function boards shall be designed to operate in the following environmental ambient conditions:
 - a. Temperature: 32 degrees F to 120 degrees F
 - b. Humidity: 0 to 95 percent RH (non-condensing)
 - c. Voltage fluctuation of +10% to -15% volts at 60 Hz and shall withstand storage conditions as follows:
 - 1) Temperature: Minus 4 degrees F to 176 degrees F
 - 2) Humidity: Zero to 95 percent RH (non-condensing)
 3. The system shall utilize PROM and RAM memory. All DDC algorithms and parameters shall be RAM based for ready access for modification and adjustment. RAM memory shall be provided with 72 hours battery backup minimum.
- C. Input/Output Equipment:
1. Input/Output (I/O) modules shall accept industrial platinum resistance sensors. Analog input resolution shall be 12 bit; 8 bit resolution controllers are not acceptable. Each output point shall be provided with a light emitting diode (LED) which shall indicate status (on-off) of digital outputs and value via variable intensity of analog outputs. Analog outputs must be true analog for proportional output control. In lieu of LEDs, individual two inch analog or one inch digital display indicators shall be provided for each analog output. Processor software shall allow for scaling and for calibration of sensor lead length variations to insure display accuracies.
 2. The following table indicates the type of sensors and signal levels that shall be used for input/output to the direct digital controllers. Reference the HARDWARE section of these specifications for further sensor requirements. Thermistor or thermocouple inputs are not acceptable.

SENSOR/OUTPUT DEVICE	SENSOR RANGE
RTDs w/Transmitters	4-20 ma, 0-10VDC
Platinum Element Direct	1000 or 3000 ohm
RTD or Balco Direct	500 or 1000 ohm

E/P Output Transducer	3-15 PSI
Pressure	4-20 ma, 0-10V, 0-1V
Others-i.e.,Current,Voltage	4-20 ma, 0-10V

3. The CUs and digital output modules shall be capable of performing two and three state output functions to emulate H-O-A switches, contact closures, etc.

D. UL Listing: The Control Unit (CU) shall be listed by Underwriters Laboratories for energy management per UL 916 standards.

E. Diagnostic Devices (DD):

1. Each Control Unit (CU) shall be supplied with connections to which maintenance personnel can connect portable diagnostic operators terminals (PDOT's) and portable programming terminal (PPT) for data display, setpoint modification, etc., and reloading and/or modification of controller programs.

F. Spare Equipment:

1. Provide spare control unit (CU) boards and spare input/output (I/O) boards as required. It shall be possible for trained hospital personnel to replace CU boards and load software via the PPT and/or the Engineering Control Center (ECC).
 - a. Provide two (2) spare control unit boards. If power supplies are separate, supply separate power supplies and other parts to make at least two complete sets of DC control equipment spares.
 - b. If input/output (I/O) boards are separate from the CU boards, provide four spare I/O boards for each spare CU board provided above.

2.4 DIRECT DIGITAL CONTROLLER SOFTWARE

- A. The DDC system shall be a network of independent standalone control units (CU). Each CU shall be capable of full control as a completely independent unit. The CUs shall include standalone capability of direct digital control with integrated energy management programs including duty cycling, time scheduling, optimum start and stop and load reset programs.
 1. The CU operating system software shall be PROM resident and operate independently of the ECC. The operating system shall provide alarm monitoring and reporting, provide control application packages, and contain built-in automatic diagnostic routines.
 2. Each CU shall contain self-diagnostics that continuously monitor the integrity of the system. Any malfunction of the system will be reported to the ECC to inform the operator of the nature of the

- malfunction of the CU's affected. The controllers shall have memory error checking. Upon detection of a memory error, the CU shall correct the error or halt to prevent erroneous operation. All halts shall be reported to the ECC.
3. After a power failure and upon a power restoration, the system shall provide automatic sequential restart of equipment based on current program time and program requirements without operator invention.
- B. All temperature control functions shall execute within the standalone 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. Each CU shall include the following standalone functions:
1. Direct Digital Control algorithms and control sequences are to be CU resident and be capable of standalone operation independent of the ECC. All DDC programs shall be custom written as required to meet the performance criteria spelled out in the sequence of operation paragraphs for each controlled mechanical system. PID algorithm shall be employed as appropriate to the application and per sequences or operation.
 2. All CU resident DDC programs shall be capable of being enabled or disabled from the ECC. In the enable mode all DDC loops shall be active and output signals shall be routed to the final control elements. In the disable mode all DDC loop calculations shall continue but outputs to actuators shall be suppressed. (When disabled, control outputs shall stay in the same state or position as commanded from the central or until they are manually set to automatic.)
 3. To eliminate integral windup, all PID programs shall automatically invoke integral windup prevention routines whenever the controlled unit is off, under manual control or under control of an EMS or time initiated program.
- C. Connect the new work to the existing Johnson (Metasys) central ECC system located in Building. New system including interface to existing systems and equipment shall operate and function as one complete system including one database of control point objects and global control logic capabilities.
- D. Default Value Operation:

1. All CU's 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, 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 central control and command station. Each CU shall have capability for local readouts of all functions.
- E. Control loops shall be able to utilize any of the following control modes:
 1. Two position (on-off, slow-fast, etc.)
 2. Proportional
 3. Proportional plus integral (PI)
 4. Proportional plus integral plus derivative (PID)
- F. Standard/Tested DDC Control Program Submodules:
 1. The following list is typical of standard direct digital control submodules that have been written, factory tested and successfully used on many projects. Proof shall be included in the submittal that such project applicable programs standard have be written, tested and successfully used by the contractor on at least five other projects.
 - a. Sequenceable analog output submodule
 - b. Sequenceable two-position output submodule
 - c. Reset main temperature setpoint submodule
 - d. Single zone control submodule
 - e. Highest of two sensors control submodule
 - f. Three input controller submodule
 - g. Fan static pressure control submodule
 - h. Differential temperature control submodule
 - i. Binary step output submodule
 - j. Step and proportional output submodule
 - k. Single zone control with heating/cooling submodule
 - l. Single input control with EMCS submodule flow charts
 2. Provide flow charts for each of the project submodule programs at time of submittal.

G. System Diagnostics:

1. Diagnostic software and hardware diagnostic software stored in non-volatile memory shall be provided for the central computer and each remote DCP (CU). Each board within each remote DCP shall independently execute its own cold-start initialization diagnostic routines. These tests shall assure that the board circuitry is operating properly and that the individual boards within the system communicate with each other properly. If any test within the system detects a problem, a message shall be output to the peripheral devices provided the failure is not within the peripheral devices themselves or within the peripheral communication circuitry. Additionally, LED indicators which are visible while the board is operating shall be provided to localize the fault. The LED indicators shall operate in addition to the peripheral device reporting.
2. Cold-start initialization diagnostics shall be initiated by power-up and operator keyboard request. Additional hardware and software shall be provided to continuously monitor on-line system operation and detect system faults.
3. Central computer diagnostics (RAM Tests): A battery of RAM diagnostics shall run upon cold-start initialization which will detect single bit, adjacent bit and column address failures. Detection of a failure shall cause an error message output to the peripheral devices.

H. Application Software:

1. All application software programs, except for power demand, shall be distributed throughout the CU's in the system. Distributed software resident in CU's shall be provided for stand-alone operation independent of the existing ECC and to improve system throughput and response time by reducing the workload on the central control. All CU's shall contain O.S. software for scheduling and controlling resident programs, and for data file management. All energy management sensor failures shall be immediately reported to the operator. Each unique application program shall be capable of being enabled or disabled by the operator from the ECC. If the CU's cannot provide the application software this capability must be supplied in the ECC.

2. Provide the following programs as a minimum:

- a. Event initiated programs (EIP): The system shall provide for a minimum of 200 event initiated programs. Event initiators may be any digital data point in the system, real time values, or any analog alarm limit. The EIPs shall be structured so that one initiator may set and reset the EIP as it goes from normal to off-normal and back to normal, or one initiator may set the program and a second initiator reset the program, or reset may be manual via the console keyboard. Setting an EIP shall cause a series of start or stop commands to assigned loads to be executed to EIP points. EIPs shall have priority assignments to allow them to override other programs in the set mode when desired. The operator's terminal shall have read-write capability for initiator load and priority assignment.
- b. Automatic restart programming: Motor in "start" mode shall not restart instantaneously when power is restored after failure. Restart shall be sequenced by the ECC restart program.
 - 1) Automatic restart of preassigned field equipment upon resumption of commercial power: Provide a computer software program that will restart field devices in preassigned sequence upon restoration of commercial power. The program shall execute the appropriate sequential commands to restore the building to a minimal, satisfactory operating condition. The operator shall be able to assign equipment to be started, on-line, through the keyboard. Indication of commercial power return as well as program initiation shall be displayed and recorded at the printer.
 - 2) Automatic restart of preassigned field equipment upon application of emergency power: Provide a computer software program that will restart field devices upon application of emergency and commercial power resumption, and shall execute the appropriate sequential minimal, satisfactory operating condition under emergency power conditions. The operator shall be able to assign equipment to be started, on-line through the keyboard.
 - 3) Indication of commercial power failure and emergency power as well as program availability initiation shall be displayed and recorded at the printer. All field cabinet (DCP) power failures shall be printed. A status message shall be printed whenever emergency or commercial power is restored. A hold interval shall be provided before program channel initiation to allow operator intervention.
- c. Preventative maintenance instruction (PMI) programming: A preventative maintenance alarm shall be printed indicating maintenance requirements based on run time. The log shall include all equipment listed in the ECC schedule that have reached limit criteria of calendar-date (month-day-year) or high accumulation of totalized run-time (for points with start/stop or run status indication). Each PMI message shall include point descriptions, limit criteria and preventative maintenance instruction assigned to that limit. PMI shall be provided for each component of units such as air handling units. All limit criteria, PMI and reset-to-zero assignments shall be operator programmable, on-line at the keyboard. Stagger initial alarms to

distribute maintenance throughout the year. Program initial PM alarms as follows:

- 1) Air handling units: 2000 hours run time.
- 2) Prefilters: 1000 hours run time
- d. Fire emergency programming.

I. Sensor and Control Devices:

1. General: Provide all remote sensing points and instrumentation as required for the systems. All sensors shall have accuracies as stated hereinafter.
2. Field wiring for each digital device shall be two or three conductor No. 18 AWG, or larger twisted sets of copper conductors 300 volts, thermoplastic. When line voltage is present in conduits or wiring trays the insulation on all conductors shall be 600 volts. For multiconductor wire having four or more conductors, wire size shall be not less than No. 20 AWG solid copper.
3. Temperature Sensors:
 - a. Temperature sensors shall be of the resistance type. Thermo-couples may be used but shall be restricted to temperature range of 500 degrees F and above.
 - b. The following shall apply to temperature sensors:
 - 1) Stem or tip sensitive types.
 - 2) Sensing elements shall be hermetically sealed.
 - 3) Stem and tip construction shall be 304 stainless steel, copper, glass or epoxy.
 - 4) All external trim material shall be corrosion resistant designed for the intended application.
 - 5) Thermometer wells shall be of bronze, stainless steel, copper, or monel materials. Heat transfer compounds shall be compatible with the sensors. At each sensor location in piping provide a well suitable for a glass stem mercury thermometer.
 - 6) Sensor accuracy: Sensors are only one element in the overall system accuracy to which the CU can respond. That response includes alarm decision, value display, value calculation on which analog values must be multiplied, subtracted, square rooted, etc. As such, the system end-to-end accuracies are herein stated. Sensors that have a tendency to drift with age shall be supplied with self-correcting circuits. Accuracy requirements also vary with application, therefore the following range/accuracies are stated:

Typical Range	Accuracy	Typical Application
-----	-----	-----
30 to 70 deg. F	plus or minus 0.5 deg. F	Chilled Water
Minus 50 to 100 deg.F	plus or minus 1.2 deg. F	O.A.
0 to 100 deg. F	plus or minus 0.7 deg. F	Space Temps

50 to 250 deg. F plus or minus 1.2 deg. F General Equip

Sensors for differential temperature readings to be used in BTU calculations shall be a matched pair with a differential accuracy of plus or minus 0.1 degrees F.

4. Differential pressure sensors:

- a. The entire assembly shall be constructed so shock, vibration and pressure surges of 25 psi above scale will neither harm the gauge nor affect its accuracy.
- b. Sensors shall have the following features:
 - 1) Adjustable high and low limits.
 - 2) Suitability for operation in an ambient temperature range of 30-140 degrees F.
 - 3) Accuracy within 5 percent of full scale.
- c. Flow status of fans, shall be proven by differential pressure switches. Provide software resident time delays to prevent false alarms during starting/stopping including printout and application programs.

5. Pressure differential switches:

- a. All pressure sensing elements shall be corrosion resistant.
- b. Pressure sensing elements shall be Bourdon tubes, bellows diaphragm or piezoelectric type.
- c. Switch type units shall have adjustable set point settings.
- d. Pressure sensor switches shall be snap action type contacts designed for the application. For logic inputs to the FID condenser for the application. For logic inputs to the FID contacts shall be short radius gold or rhodium plated to insure proper switching for the power logic circuits. When switching other items they shall be suitable for the load.
- e. Switch type sensor assemblies shall operate automatically and reset automatically when conditions return to normal.
- f. Sensor ratings: Sensors shall have the following pressure and accuracy ratings.

- 1) Chilled and hot water sensors shall be rated at 125 psig.

2.5 SYSTEM SIGNAL TRANSMISSION

A. General: All CU input signal circuits shall be in metal conduit or in approved shielded cable or both. All network communications between CUs and from CUs to the ECC must be installed in metal conduit.

- 1. Communications between direct digital controllers (CUs) shall be RS422 or 600 baud minimum with a system line capability of at least 3300 feet, or RS232C with modems.
- 2. Transmission line shall be electrically isolated from the CUs and the ECC by optical couplers at each interface to prevent any voltages in the transmission lines from damaging any of the electronic circuits.

3. Lightning protection: All cables entering or exiting a building which serve as communication links (DCP to ECC or between DCPs) shall have lightning arrestor networks installed near the point where the cable penetrates the building. Both primary detection devices (such as a three electrode gas type surge arrestor or equal) and secondary protectors shall be installed as a minimum and shall be as required to reduce dangerous voltages to nondamage levels. Fuses are not permitted as communication line lightning protection devices. Suitable forms are zener diodes, optical isolation, varistors and combinations of these with the proper interconnection circuitry. Transient protection shall protect against spikes up to 1000 volts peak voltage with a one microsecond delay time. The protective device shall be automatic, self restarting, and on duty at all times. Circuit design and protective devices shall be selected assuming a maximum of 25 ohms grounding condition.
4. All transmission bus connected devices, DCPs, etc., shall be such that loss of any single device shall not disrupt or interfere with communication to other devices on the bus. Loss of communication with the ECC shall not cause any DCP to halt operation or to cease to perform its intended function (i.e., each DCP shall continue to operate on a stand-alone basis).

B. Intercomputer Communication:

1. Intercomputer communication shall support true global control strategies as well as allow data status and values connected to one DCP to be used within application programs of another DCP.
2. The system shall provide a network communication facility to support global calculation and control strategies to be continuously implemented in the distributed system. The system shall provide for events detected in any area of the total network to initiate commands to any other device within the network. The system shall also provide for connection of calculated data to be continuously shared between any or all controllers within the total network.

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. Work Coordination: Section 00 72 00, GENERAL CONDITIONS.
3. Install equipment, piping, wiring /conduit parallel to or at right angles to building lines.
4. Install all equipment and piping in readily accessible locations. Do not run tubing and conduit concealed under insulation or inside ducts.
5. Mount control devices, tubing and conduit located on ducts and apparatus with external insulation on standoff support to avoid interference with insulation.
6. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
7. Run tubing and wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing.
8. Install equipment level and plum.

B. Piping Installation:

1. All piping associated with smoke control shall be hard drawn copper.
2. Tubing passing through or buried in concrete shall be installed in rigid steel conduit of sufficient strength to prevent damage to tubing.
3. Except for short apparatus connections, non-metallic tubing in all exposed locations, including mechanical rooms shall be protected from damage by installing the tubing in electric conduit or raceways. Provide protective grommet where tubing exits conduit.
4. Non-metallic tubing exposed to outdoors shall be protected by a sleeve or larger tubing.
5. In concealed but accessible locations such as above lay-in ceilings, non-metallic tubing may be run without conduit or raceway.
6. All tubing which is not run in conduit or raceway, both metallic and non-metallic, shall be neatly routed and securely fastened to building structure at not more than 36-IN. intervals.
7. Welding shall be performed in accordance with Section 23 21 13, HYDRONIC PIPING.

8. Label and identify control air piping in accordance with specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

C. Electrical Wiring Installation:

1. Install conduits and wiring in accordance with Specification Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
2. Install signal and communication cables in accordance with Specification Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
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. All wiring shall be installed in conduits.
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 power is required, provide suitable 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.

D. 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.
- 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.
- E. 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: 10 Base 2 (ThinNet RG-58 A/U Coaxial cabling with BNC connectors), 10 Base T (Twisted-Pair RJ-45 terminated UTP cabling).
 2. Echelon:
 - a. The ECC shall employ LonTalk communications FTT-10.

- b. Echelon LAN (Flat LON): The ECC shall employ a LON LAN that will connect through an Echelon Communication card directly to all controllers on the FTT-10 LAN.
- 3. 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.
- F. Installation of Digital Controllers and Programming:
 - 1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, chiller, pumping unit etc. Points used for control loop reset such as outdoor air, outdoor humidity, or space temperature could be located on any of the remote control units.
 - 2. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25 percent of available memory free for future use.
 - 3. System point names shall be modular in design, permitting easy operator interface without the use of a written point index.
 - 4. Provide software programming for the applications intended for the systems specified, and adhere to the strategy algorithms provided.
 - 5. Provide graphics for each piece of equipment and floor plan in the building. This includes each chiller, cooling tower, air handling unit, fan, terminal unit, boiler, pumping unit etc. These graphics shall show all points dynamically as specified in the point list.

3.2 SYSTEM VALIDATION AND DEMONSTRATION

- A. As part of final system acceptance, a System Demonstration is required (see below). Prior to start of this Demonstration, the contractor is to perform a complete Validation of all aspects of the Controls and Instrumentation System.
- B. Validation
 - 1. Prepare and submit for approval a Validation Test Plan including Test Procedures for the performance verification tests. Test Plan shall address all specified functions of the Engineering Control Center including ability to communicate with all new control units, sensors and control devices. Test Plan shall address 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 Owner's representative on random samples of equipment as dictated by the Owner'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 owner.
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. Pressure test control air piping at 1.25 times the design pressure. Pressure shall be applied in several stages, allowing time for the system to reach equilibrium. The test pressure shall not exceed the pneumatic test pressure for any pump, valve, or other component in the system under test. Pressure shall not drop more than 5% within 4 hours.
 - b. Observe HVAC systems in shut down condition. Check dampers and valves for normal position.

- c. Test application software for its ability to communicate with digital controllers, operator workstation, and uploading and downloading of control programs.
 - d. Demonstrate the software ability to edit the control program off-line.
 - e. Demonstrate reporting of alarm conditions for each alarm and ensure that these alarms are received at the assigned location, including operator workstations.
 - f. Demonstrate ability of software program to function for the intended applications-trend reports, change in status etc.
 - g. 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.
 - h. 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.
 - i. 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.
 - j. 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 validation demonstration of Operator's Terminal functions shall consist of:
- a. Running each specified report.
 - b. Display and demonstrate each data entry to show site specific customizing capability. Demonstrate parameter changes.
 - c. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
 - d. Execute digital and analog commands in graphic mode.
 - e. Demonstrate DDC loop precision and stability via trend logs of inputs and outputs (6 loops minimum).
 - f. Demonstrate EMS performance via trend logs and command trace.
 - g. Demonstrate scan, update, and alarm responsiveness.

- h. Demonstrate spreadsheet/curve plot software, and its integration with database.
- i. Demonstrate on-line user guide, and help function and mail facility.
- j. Demonstrate digital system configuration graphics with interactive upline and downline load, and demonstrate specified diagnostics.
- k. Demonstrate multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
- l. Demonstrate class programming with point options of beep duration, beep rate, alarm archiving, and color banding.

----- END -----

SECTION 23 09 24
CONTROLS AND INSTRUMENTATION (T-STAT)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Control devices and systems to provide the functional requirements of these specifications and as shown on the contract drawings.

1.2 RELATED WORK

- A. Section 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT

1.3 QUALITY ASSURANCE

- A. Criteria:
 - 1. 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.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS.
- B. Manufacturer's literature and data for all components including the following:
 - 1. Digital JC METYSIS compatible thermostat or equal.
 - 2. Solar/Batterypowered wireless thermostat as a cost effective option, this manufacturer needs to be utilized due to the compatibility of the existing backbone network for controls.
 - 3. Ceiling mounted local visual failure unit alarm for any new air handler supporting critical care units.

1.5 APPLICABLE PUBLICATIONS

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

- A. Federal Specifications (Fed. Spec.):
GG-T-321D(2).....Thermometers, Self-Indication,
Liquid-in-glass for Machinery and Piping Systems
- B. American National Standards Institute (ANSI):
B16.22-80.....Wrought Copper and Copper Alloys - Solder
Joint Pressure Fittings
- C. American Society of Heating, Refrigerating and Air Conditioning
Engineers, Inc. (ASHRAE):
1987 Systems Handbook

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

B88-86.....Seamless Copper Water Tube

B280-83.....Seamless Copper Tube for Air Conditioning
and Refrigeration Field Service

B486-74.....Paste Solder

D635-81.....Rate of Burning and/or Extent and Time of
Burning of Self-Supporting Plastics in a Horizontal Position

D1693-70.....Environmental Stress-Cracking of Ethylene
Plastics

E. Instrument Society of America (ISA):

57.3-75.....Quality Standard for Instrument Air (R1981)

F. National Fire Protection Association (NFPA):

70-87.....National Electrical Code

90A-85.....Installation of Air Conditioning and
Ventilating Systems

G. Scientific Apparatus Makers Association (SAMA): Standard

PMC20.1-1973.....Process Measurement and Control Terminology

H. Underwriters Laboratories (UL):

UL 94-80.....Test for Flammability of Plastic Materials
for Parts in Devices and Appliances

PART 2 - PRODUCTS

2.1 THERMOSTATS

- A. Room thermostats controlling heating and cooling devices shall have three modes of operation (heating - null or dead band - cooling). Wall mounted thermostats shall have polished or brushed aluminum finish, setpoint and temperature display and external adjustment.

1. Digital thermostats shall be low voltage, reduced from 120/208v from (Terminal Box) control power.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Workmanship: Provide skilled technicians, properly trained and qualified for the work and directed by experienced engineers. Only JC Metasys certified engineers and technicians are allowed to carry out the work and ensure that seamless communication and interface with the existing system will be achieved.

2. Work coordination: Section, GENERAL CONDITIONS.
 3. Electrical work and safety requirements: NFPA 70 and ANSI C2, and referenced electrical sections of these specifications.
 4. Wiring: The term wiring is construed to include furnishing of wire, conduit, miscellaneous material and labor to install a working system. Outdoor installations shall be of weatherproof construction or in NEMA 3R or 4 enclosures.
 5. Welding and piping: Perform in accordance with industry standards.
 6. Except for short apparatus connections, run conduit to or at right angles to the building structure. Conceal conduit in finished spaces.
 7. Do not run conduit concealed under insulation or inside ducts. Mount control devices, and conduit located on ducts or apparatus with external insulation on stand-off support to avoid interference with insulation.
 8. Run wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing. Rack connections bridging a cabinet door along the hinge side and protect from damage. Provide grommets, sleeves or vinyl tape to protect wires from sharp edges of panels, conduit, and other items.
 9. Equipment and materials identification: Section 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT
- B. Field Materials:
1. Sensors and controls:
 - a. Provide all remote sensors and instrumentation.
 - b. 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.
 - c. Label or code each field wire at each end. 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.
 - d. Temperature sensors:
 - 1) Temperature sensors shall be readily accessible and adaptable to each type of application in such a manner as to permit for quick, easy replacement and servicing without special tools or skills.

- 2) Mount duct sensors in locations to sense the correct temperature of the air only, within the vibration and velocity limits of the sensing element. Mount extended surface element, when used, securely within the duct and position to measure the best average temperature. Thermally isolate elements from brackets and supports to respond to air temperature only. Securely seal duct penetrations.
 2. DCPs: Install in accordance with manufacturer's published instructions and requirements.
- C. Signal Transmission System Equipment:
1. General: Install all system components in accordance with the National Electrical Code and the manufacturer's recommendations; fuse and ground them properly.
 - 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 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:
 - 1) Keep cable runs as short as possible. Allow extra length for connecting to the terminal board.
 - 2) Do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter.
 - 3) Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.
 2. Grounding:
 - a. Ground system per manufacturer's requirements for proper and safe operation.

- - - E N D - - -

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.
 - 4. Factory prefabricated (preinsulated) chilled water piping for underground service. Steel or copper piping with field applied closed cell cellular glass insulation, Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION may be furnished for underground piping in lieu of factory prefabricated (preinsulated) piping.
 - 5. Factory prefabricated (preinsulated) chilled water piping, with metal carrier pipe and metal jacket, may be provided in utility tunnels, pipe basements and crawl spaces, in lieu of field insulated piping.

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: Seismic restraints for piping.
- D. 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.
- E. Section 23 21 23, HYDRONIC PUMPS: Pumps.
- F. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Piping insulation.
- H. Section 23 21 13, HYDRONIC PIPING: Underground chilled water piping.
- I. 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. Design Working Pressure for Preinsulated Chilled Water Piping: 861 kPa (125 psig).

- C. 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.
- D. Manufacturers Training Service: The Contractor shall obtain the services of an independent trained representative of the preinsulated chilled water pipe system manufacturer to instruct contractor's work force in installation procedures for all preinsulated, prefabricated systems.
- E. On Site Supervision of Underground Preinsulated Chilled Water Piping Installation:
 - 1. Provide services of a factory trained representative of the pipe manufacturer for a minimum of three days, to include pre installation, installation and testing periods.
 - 2. Representative's daily written reports to the Resident Engineer: Present the original of each report on the day it is prepared and forward a copy to the manufacturer's main office. The report shall be signed by the manufacturer's representative. The report shall state whether or not the condition and quality of the materials used and the installation of the system is in accordance with the plans, specifications, and published standards of the manufacturer, and is satisfactory in all respects. If anything connected with the installation is unsatisfactory, the report shall state that corrective action has been taken or shall contain the manufacturer's recommendations for corrective action. The report shall cover any condition that could result in an unsatisfactory installation. The representative shall take prompt action to return to the factory all damaged and defective material, and shall order prompt replacement of such material.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Pipe and equipment supports. Submit calculations for variable spring and constant support hangers.
 - 2. Pipe and tubing, with specification, class or type, and schedule.
 - 3. Pipe fittings, including miscellaneous adapters and special fittings.

4. Flanges, gaskets and bolting.
 5. Valves of all types.
 6. Strainers.
 7. Flexible connectors for water service.
 8. Pipe alignment guides.
 9. Expansion joints.
 10. Expansion compensators.
 11. All specified hydronic system components.
 12. Water flow measuring devices.
 13. Gages.
 14. Thermometers and test wells.
 15. Seismic bracing details for piping.
 16. Factory preinsulated piping components and installation instructions.
 17. Pipe fittings, and mechanical couplings, if used, for preinsulated chilled water piping.
 18. Anchors and thrust blocking for preinsulated chilled water piping.
- C. Manufacturer's certificates for underground preinsulated chilled water piping:
1. That the field representative for the factory insulated pipe installation is technically qualified and experienced in installation of the manufacturer's system and is qualified to provide the required site reports.
 2. Upon completion of the work and before final acceptance, the Contractor shall deliver a notarized statement, signed by a principal officer of both the manufacturing firm and the contracting firm, stating that the installation is satisfactory and in accordance with the plans, specifications, and manufacturer's standards.
- D. 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.
- E. Calculations for thrust blocking for underground preinsulated piping.
- F. Coordination Drawings: Refer to Article, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

G. As-Built Piping Diagrams: Provide drawing as follows for chilled water, condenser water, and heating hot water system and other piping systems and equipment. .

1. One wall-mounted stick file with complete set of prints. Mount stick file in the chiller plant or control room along with control diagram stick file.
2. One complete set of reproducible drawings.
3. One complete set of drawings in electronic format (Autocad, pdf, or other approved format).

1.5 APPLICABLE PUBLICATIONS

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

B. American Society of Mechanical Engineers (ASME):

- B1.20.1-83.....Pipe Threads, General Purpose (Inch)
- B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings
- B16.3-98.....Malleable Iron Threaded Fittings
- B16.4-98.....Gray Iron Threaded Fittings
- B16.5-03.....Pipe Flanges and Flanged Fittings
- B16.9-03.....Factory-Made Wrought Buttwelding Fittings
- B16.11-05.....Forged Fittings, Socket-Welding and Threaded
- B16.14-91.....Ferrous Pipe Plugs, Bushings, and Locknuts with
Pipe Threads
- B16.22-01.....Wrought Copper and Copper Alloy Solder-Joint
Pressure Fittings
- B16.23-02.....Cast Copper Alloy Solder Joint Drainage
Fittings
- B16.24-01.....Cast Copper Alloy Pipe Flanges and Flanged
Fittings, Class 150, 300, 400, 600, 900, 1500
and 2500
- B16.39-98.....Malleable Iron Threaded Pipe Unions, Classes
150, 250, and 300
- B16.42-98.....Ductile Iron Pipe Flanges and Flanged Fittings:
Classes 150 and 300
- B31.1-01.....Power Piping
- B31.9-04.....Building Services Piping
- B40.100-05.....Pressure Gauges and Gauge Attachments

C. American National Standards Institute, Inc. (ANSI):

- B16.1 00.....Cast Iron Pipe Flanges and Flanged Fittings,
Class 25, 125 and 250
- B16.3 00.....Malleable Iron Threaded Fittings Classes 150
and 300
- B16.5 03.....Pipe Flanges and Flanged Fittings NPS ½ through
NPS 24
- B16.9 03.....Factory Made Wrought Butt Welding Fittings
- B16.11 01.....Forged Fittings, Socket Welding and Threaded
- B16.14 91.....Ferrous Pipe Plugs, Bushings and Locknuts with
Pipe Threads
- B16.18-01.....Cast Copper Alloy Solder joint Pressure
fittings
- B16.22 00.....Wrought Copper and Bronze Solder Joint Pressure
Fittings
- B16.24 01.....Cast Copper Alloy Pipe Fittings and Flanged
Fittings: Class 150, 300, 400, 600, 900, 1500
and 2500
- B31.1 01.....Power Piping

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

- A47/A47M-99 (2004).....Ferritic Malleable Iron Castings
- A53/A53M-06.....Standard Specification for Pipe, Steel, Black
and Hot-Dipped, Zinc-Coated, Welded and
Seamless
- A106/A106M-06.....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
- A181/A181M-01.....Standard Specification for Carbon Steel
Forgings, for General-Purpose Piping
- A183-03 Standard Specification for Carbon Steel Track
Bolts and Nuts
- A216/A216M-04 Standard Specification for Steel Castings,
Carbon, Suitable for Fusion Welding, for High
Temperature Service

A234/A234M 04 Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

A307-04 Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

A536-84 (2004) Standard Specification for Ductile Iron Castings

A 615/A 615M-04 Deformed and Plain Carbon Steel Bars for Concrete Reinforcement

A653/A 653M-04 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) By the Hot-Dip Process

B32-04 Standard Specification for Solder Metal

B61-02 Standard Specification for Steam or Valve Bronze Castings

B62-02 Standard Specification for Composition Bronze or Ounce Metal Castings

B88-03 Standard Specification for Seamless Copper Water Tube

B209 04 Aluminum and Aluminum Alloy Sheet and Plate

C177 97 Standard Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus

C478-03 Precast Reinforced Concrete Manhole Sections

C533 03 Calcium Silicate Block and Pipe Thermal Insulation

C552 03 Cellular Glass Thermal Insulation

D 3350-02 Polyethylene Plastics Pipe and Fittings Materials

C591-01 Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

D1784 03 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

D1785 03 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120

D2241 04 Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)

- D2464 99 Threaded Poly (Vinyl Chloride) (PVC) Plastic
Pipe Fittings, Schedule 80.
- D3139 98 Joints for Plastic Pressure Pipes Using Flexible
Elastomeric Seals
- 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
- F477-02 Elastomeric Seals Gaskets) for Joining Plastic
Pipe
- E. American Water Works Association (AWWA):
- C110/03.....Ductile Iron and Grey Iron Fittings for Water
- C203 00.....Coal Tar Protective Coatings and Linings for
Steel Water Pipe Lines Enamel and Tape Hot
Applied
- F. American Welding Society (AWS):
- A5.8/A5.8M-04.....Specification for Filler Metals for Brazing and
Braze Welding
- B2.1-02.....Standard Welding Procedure Specification
- G. Copper Development Association, Inc. (CDA):
- CDA A4015-95.....Copper Tube Handbook
- H. Expansion Joint Manufacturer's Association, Inc. (EJMA):
- EMJA-2003.....Expansion Joint Manufacturer's Association
Standards, Eighth Edition
- I. 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-72-99.....Ball Valves with Flanged or Butt-Welding Ends
for General Service
- SP-78-05.....Cast Iron Plug Valves, Flanged and Threaded
Ends

SP-80-03.....Bronze Gate, Globe, Angle and Check Valves
SP-85-02.....Cast Iron Globe and Angle Valves, Flanged and
Threaded Ends

J. National Sanitation Foundation (NSF):

14 03.....Plastic Piping System Components and Related
Materials

K. Tubular Exchanger Manufacturers Association: TEMA 8th Edition, 2000

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

HVAC Duct Construction Standards, 2nd Edition 1997

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR
HVAC AND STEAM GENERATION.

2.2 PIPE AND TUBING

A. Chilled Water (above ground), Condenser Water (above ground), Heating
Hot 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. Soft
drawn tubing, 20 mm (3/4 inch) and larger, may be used for runouts
to floor mounted fan coil units.
3. Chilled water piping underground and optional piping in utility
tunnels, pipe basements and crawl spaces: Factory prefabricated
(preinsulated chilled water piping).

B. Cooling Coil Condensate Drain Piping:

1. From air handling units: Copper water tube, ASTM B88, Type M, or
schedule 80 flame retardant polypropylene plastic.
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. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints. Mechanical
couplings and fittings are optional for water piping only.

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.
- B. 50 mm (2 inches) and Smaller: Screwed or welded. Mechanical couplings are optional for water piping only.
 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.
- 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. 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.
 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 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. Solder Joint:

1. Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
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.

2.5 FITTINGS FOR PLASTIC PIPING

- A. Schedule 80, socket type for solvent welding.
- B. Polypropylene drain piping: Flame retardant, 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).

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. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.
- C. Provide chain operators for valves 100 mm (4 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.

D. Gate Valves:

1. 50 mm (2 inches) and smaller: MSS-SP80, Bronze, 1034 kPa (150 lb.), wedge disc, rising stem, union bonnet.
2. 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke.
 - a. MSS-SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.

E. Globe, Angle and Swing Check Valves:

1. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.) Globe and angle valves shall be union bonnet with metal plug type disc.
2. 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for globe valves and MSS-SP-71 for check valves.

F. 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.

1. Body: Cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
2. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.

G. Butterfly Valves: May be used in lieu of gate valves in water service except for direct buried pipe. Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation.

1. MSS-SP 67, flange lug type (for end of line service) or grooved end rated 1205 kPa (175 psig) working pressure at 93 degrees C (200 degrees F).
 - 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.

H. Ball Valves: Brass or bronze body with chrome-plated ball with full port and Teflon seat at 4140 kPa (600 psig) working pressure rating. Screwed or solder connections. Provide stem extension to allow operation without interfering with pipe insulation.

I. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size and be one of the following types.

2. Eccentric plug valve: Iron body, bronze or nickel-plated iron plug, bronze bearings, adjustable memory stop, operating lever, rated 861 kPa (125 psig) and 121 degrees C (250 degrees F).

J. 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.

2.9 WATER FLOW MEASURING DEVICES

- A. Minimum overall accuracy plus or minus three percent over a range of 70 to 110 percent of design flow. Select devices for not less than 110 percent of design flow rate.
- B. Venturi Type: Bronze, steel, or cast iron with bronze throat, with valved pressure sensing taps upstream and at the throat.
- C. Wafer Type Circuit Sensor: Cast iron wafer-type flow meter equipped with readout valves to facilitate the connecting of a differential pressure meter. Each readout valve shall be fitted with an integral check valve designed to minimize system fluid loss during the monitoring process.
- D. Self-Averaging Annular Sensor Type: Brass or stainless steel metering tube, shutoff valves and quick-coupling pressure connections. Metering tube shall be rotatable so all sensing ports may be pointed down-stream when unit is not in use.
- E. Flow Measurement/Balance Valves: A system comprised of two valves of bronze and stainless steel metallurgy designed for 1205 kPa (175 psig) pressure at 121 degrees C (250 degrees F), with thermal insulation sleeve.
 - 1. Measurement and shut-off valve: An on/off ball valve with integral high regain venturi and dual quick connect valves with integral check valves and color coded safety caps for pressure/temperature readout.
 - 2. A butterfly balancing valve as specified herein, with memory stop and quick connect valve for pressure/temperature readout.
- F. Insertion Turbine Type Sensor: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- G. Flow Measuring Device Identification:
 - 1. Metal tag attached by chain to the device.
 - 2. Include meter or equipment number, manufacturer's name, meter model, flow rate factor and design flow rate in l/m (gpm).

2.10 STRAINERS

- A. Basket or Y Type. Tee type is acceptable for water service.
- B. 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.

1. 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.

C. Suction Diffusers: Specified in Section 23 21 23, HYDRONIC PUMPS.

2.11 FLEXIBLE CONNECTORS FOR WATER SERVICE

A. Flanged Spool Connector:

1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
2. Working pressures and temperatures shall be as follows:
 - a. Connector sizes 50 mm to 100 mm (2 inches to 4 inches), 1137 kPa (165psig) at 121 degrees C (250 degrees F).
 - b. Connector sizes 125 mm to 300 mm (5 inches to 12 inches), 965 kPa (140 psig) at 121 degrees C (250 degrees F).
3. Provide ductile iron retaining rings and control units.

B. Mechanical Pipe Couplings:

See other fittings specified under Part 2, PRODUCTS.

2.12 HYDRONIC SYSTEM COMPONENTS

- A. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 28 kPa (4 psig) above and below set point. Bronze, brass or iron body and bronze, brass or stainless steel trim, rated 861 kPa (125 psig) working pressure at 107 degrees C (225 degrees F).
- B. Pressure Relief Valve: Bronze or iron body and bronze or stainless steel trim, with testing lever. Comply with ASME Code for Pressure Vessels, Section 8, and bear ASME stamp.
- C. 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. Pipe air outlet to drain.

2.13 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).

2.14 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.

2.15 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 may be slightly greater than shown to meet manufacturer's standard. Required ranges in degrees C (F):

Chilled Water and Glycol-Water 0 to 38 degrees C (32-100 degrees F)	Hot Water and Glycol-Water -1 to 116 degrees C (30 to 240 degrees F).
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2.16 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 convertors and other heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.
- D. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope 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 air vent at all piping system high points and drain valves at all low points.
- 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.
- F. Pipe Sleeves:
 - 1. Pipe shall be continuous through sleeves. Set in place before concrete is poured.
 - 2. Seal between sleeve and core opening with modular mechanical type link seal.
 - 3. Provide where water lines pass through retaining walls and foundation walls.
- G. Cutting of Prefabricated Conduit Sections: Prefabricated conduit sections shall be cut in strict accordance with the manufacturer's recommendations and standards. The cut section shall be treated as required to result in the cut section being identical in every respect to a standard conduit section produced at the factory.
- H. Field Casing Closures: Field insulation and encasement of joints shall be accomplished after the visual and pressure tests specified are completed. Field insulation and encasement shall be in accordance with the manufacturer's written instructions. Thickness dimensions of the insulation and casing materials shall not be less than those of the adjoining prefabricated section. Insulating material may be foamed in place polyurethane or premolded polyurethane foam sections. Care should be taken to ensure that field closures are made under conditions of temperature and cleanliness required to produce a sound continuous vapor barrier. A standard polyethylene heat shrink sleeve shall be installed over the casing and shall have a 150 mm (6-inch minimum) overlap at each end.
- I. Insulation and Encasement of Pipe Accessories: Flanges, couplings, unions, valves, fittings, and other pipe accessories, unless otherwise shown or approved, shall be insulated with removable factory premolded, prefabricated or field fabricated insulation. For accessories buried underground, the casing material and thickness shall be identical to that of the adjoining casing material and thickness shall be identical to that of the adjoining casing except that for polyethylene casing larger than 300 mm (12-inch) size, the casing material over fittings

shall be reinforced thermosetting resin (RTRP). For accessories in manholes, the casing material shall be steel or aluminum sheet applied over the insulation. Where accessories are designated not to be insulated, the adjoining insulation and jacket shall terminate neatly and in a manner to provide a complete vapor seal.

- J. Open Ends: Open ends of pipe lines and equipment shall be properly capped or plugged during installation to keep dirt and other foreign matter out of the system.
- K. Vapor Barrier: Install materials to provide and preserve the integrity of the vapor barrier.

3.3 SEISMIC BRACING ABOVEGROUND PIPING

Provide in accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

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 and outside air systems.
- B. Definitions:
 - 1. SMACNA Standards as used in this specification means the 1985 HVAC Duct Construction Standards, Metal and Flexible.
 - 2. Seal or sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
 - 3. Duct pressure classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
 - 4. Exposed duct: Exposed to view in a finished room.

1.2 RELATED WORK

- A. Section 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALITY ASSURANCE, in Section, 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT
- 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:
 - 1. Leakage classification and allowable leakage: In accordance with Section 4 of SMACNA HVAC Air Duct Leakage Test Manual.
 - 2. No duct air leakage test is required but VA reserves the right to make leakage tests or to have air leakage tests performed by the contractor at Government expense. Tests shall be performed in accordance with SMACNA HVAC Air Duct Leakage Test Manual.
- E. Duct accessories exposed to the air stream, such as dampers of all types 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

In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, furnish the following:

- A. 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. Volume dampers, backdraft dampers.
 3. Upper hanger attachments.
 4. Fire dampers, fire doors, with installation instructions.
 5. Sound attenuators, including pressure drop and acoustic performance.
 6. Flexible connections.
 7. Instrument test fittings.
- B. Coordination Drawings: Section, 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT

1.5 APPLICABLE PUBLICATIONS

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

- A. Federal Specifications (Fed. Spec.):
- HH-1-545(1) 1976.....Insulation, Thermal and Acoustical (Mineral Fiber INT AMD 2 Duct Lining Material)
- B. Air Diffusion Council Test Code:
- 1062R4.....Certification, Rating, and Test Manual (1977)
- C. Air Moving and Conditioning Association (AMCA):
- 500-75.....Test Method and Louvers, Dampers and Shutters
- D. American Society for Testing and Materials (ASTM):
- A167-84.....Stainless and Heat-Resisting Chromium-Nickel, Steel Plate, Sheet and Strip.
- A527-85.....Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
- A569-85.....Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet Commercial Quality.
- B209-86.....Aluminum and Aluminum-Alloy Sheet and Plate.

- E84-84.....Surface Burning Characteristics of Building Materials
- E. National Fire Protection Association (NFPA):
- 90A.....Installation of Air Conditioning and Ventilating Systems - 1985
- 96.....Removal of Smoke and Grease-Laden Vapors From Cooking Equipment - 1984
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
- HVAC Duct Construction Standards, Metal and Flexible, 1st Edition - 1985
- HVAC Air Duct Leakage Test Manual, 1st Edition, 1985
- G. Underwriters Laboratories, Inc. (UL):
- 33-82.....Heat Responsive Links for Fire Protection Service
- 181-84.....Factory-Made Air Ducts and Connectors
- 555-79.....Fire Dampers and Ceiling Dampers
- 555S-09/83.....Leakage Rated Dampers for Use in Smoke Control Systems

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 A527, coating G90, or aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.
- B. Joint Sealing: Refer to SMACNA Standards, paragraph S1.8 and 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.
- C. Approved factory made joints such as DUCTMATE SYSTEM may be used.

2.2 DUCT CONSTRUCTION AND INSTALLATION

- A. Follow SMACNA HVAC Duct Construction Standards.
- B. Seal Classes: As shown on the drawings and in accordance with SMACNA HVAC Air Duct Leakage Test Manual.
- C. Duct for Negative Pressure Up to 3 Inches Water Gage.
 - 1. Rectangular duct: Galvanized steel, minimum 20 gage, pittsburgh lock seam, companion angle joints (1-1/4 by 1/8 minimum) at not more than 8 foot spacing. DUCTMATE SYSTEM or equal manufactured joints are acceptable in lieu of companion angles.
- D. Casings and Plenums: Construct in accordance with SMACNA Standards Section VI, including access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 20 inches wide by 48 - 54 inches high. Provide viewport in the doors where shown.
- E. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards.
- F. Duct Hangers and Supports: Refer to SMACNA Standards Section IV.

2.3 DUCT LINER

- A. Duct sizes shown on drawings for lined duct are clear opening inside lining.
- B. Rectangular Duct or Casing Liner: Fed. Spec. HH-I-545, Type I (flexible), or Type II (board), one inch minimum thickness, applied with mechanical fasteners and 100 percent coverage of adhesive in conformance with SMACNA, Duct Liner Application Standard.

2.4 DUCT ACCESS DOORS, PANELS AND SECTIONS

- A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:
 - 1. Each fire damper (for link service).
 - 2. Each duct mounted smoke detector.
- B. Openings shall be as large as feasible in small ducts, 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 Standards (Figure 2-12).

2.5 FIRE DAMPERS

- A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2 hour rating, 160 degrees F fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream. Fire dampers in wet air exhaust shall be stainless steel construction, all others may be galvanized steel.

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 14 gage, required to provide installation equivalent to the damper manufacturer's UL test installation.
2. Submit manufacturers installation instructions conforming to UL rating test.

2.6 FLEXIBLE CONNECTIONS

- A. Where duct connections are made to air handling units, install a non-combustible flexible connection of 29 ounce neoprene coated fiberglass fabric approximately six inches wide. Burning characteristics shall conform to NFPA 90A. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws two inches on center. Fabric shall not be stressed other than by air pressure. Allow at least one inch slack to insure that no vibration is transmitted.
- B. Where ducts or fire damper frames of dissimilar metal are connected, provide a coupling consisting of flanges, neoprene gaskets, fabric, and nuts and bolts.

2.7 SOUND ATTENUATING UNITS

- A. Casing, not less than 20 gage galvanized sheet steel, or 18 gage aluminum fitted with suitable flanges to make clean airtight connections to ductwork. Sound-absorbent material faced with glass fiber cloth and covered with not less than 24 gage or heavier galvanized perforated sheet steel, or 22 gage or heavier perforated aluminum. Perforations shall not exceed 5/32-inch diameter, approximately 25 percent free area. Sound absorbent material shall be long glass fiber acoustic blanket meeting requirements of NFPA 90A.
- B. Entire unit shall be completely air tight and free of vibration and buckling at internal static pressures up to eight inch water gage at operating velocities.
- C. Pressure drop through each unit: Not to exceed indicated value at design air quantities indicated.
- D. Submit complete independent laboratory test data showing pressure drop and acoustical performance.
- E. Cap open ends of attenuators at factory with plastic, heavy duty paper, cardboard, or other appropriate material to prevent entrance of dirt, water, or any other foreign matter to inside of attenuator. Caps shall not be removed until attenuator is installed in duct system.

2.8 NOT USED

2.9 SEISMIC RESTRAINT FOR DUCTWORK

Provide seismic restraint for ductwork per, "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems".

- A. Provide required bracing material.

- B. Ductwork shall be supported and braced to resist all directional (transverse, longitudinal and vertical) forces equal to 50 percent of the weight of the duct system.

2.10 NOT USED

2.11 INSTRUMENT TEST FITTINGS

- A. Manufactured type with a minimum two inch length for insulated duct, and a minimum one inch length for duct not insulated. Test hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.
- B. Provide instrument test holes at each duct or casing mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil, and cooling coil.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with provisions of Section, BASIC METHODS AND REQUIREMENTS (MECHANICAL), 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. Fabricate ductwork based on field measurements of space available. Duct sizes on the drawings are inside dimensions which shall be altered by the Contractor, when approved by the Project Engineer, to other dimension producing 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 including web members of existing trusses. Sheet metal shall fully isolate structural truss web members from air stream. Repair galvanized areas with galvanizing repair compound.
 - 3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards, Section VI.
 - 4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Section VI. 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, Section IV.
- D. Install fire dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test.
- E. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.

- F. Low Pressure Duct Liner: Install in accordance with SMACNA, Duct Liner Application Standard.
- G. 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 Project 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. Perform tests if required. See paragraph, QUALITY ASSURANCE.
- B. Seal all visible openings in ducts particularly at notches on rectangular duct joints. Seal air leaks audible at system operating conditions.

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SECTION 23 43 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 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT
- B. Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT
- C. Section 23 73 00, INDOOR CENTRAL STATION AIR HANDLING UNITS

1.3 QUALITY ASSURANCE

- A. Refer to paragraph, QUALITY ASSURANCE, in Section, 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT
- B. Fans and power ventilators shall be listed in the current edition of AMCA 261, and shall bear the AMCA performance seal.
- C. Operating or 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 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT
- F. Performance Criteria:
 - 1. The fan schedule shows CFM and design static pressure. Scheduled fan motors, 1/2 horsepower and larger, are sized for design CFM at 110 percent design static pressure, but not to exceed 3/4-inch additional pressure.
 - 2. Provide fans and motors capable of stable operation at design conditions and at 110 percent pressure as stated above.
 - 3. Lower than design pressure drop of approved individual components may allow use of a smaller fan motor and still provide the safety factor. When submitted as a deviation a smaller motor may be approved in the interest of energy conservation.
 - 4. Select fan operating point as follows:
 - a. Forward curved: Right hand side of peak pressure point.
 - b. Airfoil and backward inclined fans: Near the peak of static efficiency.

G. Corrosion Protection:

1. Except for fans in fume hood and safety cabinet 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 G23 weathermeter.
2. Coating for fans in fume hood and safety cabinet exhaust service: AMCA Standard preparation for coating 2601-66-2C33 finished with two coats of epoxy-ester, such as Carboline 110. Provide manufacturer's standard outside finish.

1.4 SUBMITTALS

In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, furnish the following:

A. Manufacturers Literature and Data:

1. Fan sections, motors and drives.
2. Centrifugal fans, motors, drives, accessories and coatings.
 - a. Utility fans and vent sets.

B. Sound power levels for each fan.

C. Maintenance and operating manuals in accordance with Section 01010, GENERAL REQUIREMENTS.

D. Fan curves for each fan showing CFM versus static pressure, efficiency, and horsepower for design point of operation and at 110 percent of design static pressure. Include product application data to indicate the effect of capacity control devices such as inlet vane dampers on flow, pressure and horsepower.

1.5 APPLICABLE PUBLICATIONS

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

A. Air Moving and Control Association (AMCA):

99-83.....Standards Handbook

210-74.....Laboratory Methods of Testing Fans for Rating Purposes

261.....Directory of Products Licensed To Bear The AMCA
Certified Ratings Seal - Published Annually

300-67.....Test Code for Sound Rating. Air Moving Devices

- B. American Society for Testing and Materials (ASTM):
 - B117-85.....Salt Spray (Fog) Testing
 - D1735-62.....Water Fog Testing of Organic Coatings
 - D3359-83.....Measuring Adhesion by Tape Test
 - G23-81.....Operating Light-Exposure Apparatus
- C. Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA):
 - 9-1978....Load Ratings and Fatigue Life for Ball Bearings
- D. National Fire Protection Association (NFPA)

PART 2 - PRODUCTS

2.1 FAN SECTION (CABINET FAN)

- A. Refer to Section, 23 73 00, INDOOR CENTRAL STATION AIR HANDLING UNITS

2.2 CENTRIFUGAL FANS

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE. Record factory vibration test results on the fan or furnish to the Contractor.
- B. Fan arrangement, unless noted or approved otherwise:
 - 1. DWD1 fans: Arrangement 3.
 - 2. SWS1 fans: Arrangement 1, 3, 9 or 10, except fume hood and safety cabinet exhaust fans shall not be arrangements
- C. Construction: Wheel diameters and outlet areas shall be in accordance with AMCA standards.
 - 1. Housing: Low carbon steel, arc welded throughout, braced and supported by structural channel or angle iron to prevent vibration or pulsation, flanged outlet, inlet fully streamlined. Provide lifting clips, and casing drain. Provide manufacturer's standard access door.
 - 2. Wheel: Steel plate with die formed blades welded or riveted in place, factory balanced statically and dynamically.
 - 3. Shaft: Designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fans class.
 - 4. Bearings: Heavy duty ball or roller type sized to produce a B10 life of not less than 40,000 hours, and an average fatigue life of 200,000 hours. Extend lubrication tubes for interior bearings or ducted units to outside of housing.
 - 5. Motor, adjustable motor base, drive and guard: Furnish from factory with fan. Refer to Section, BASIC METHODS AND REQUIREMENTS (MECHANICAL) for specifications. Provide protective sheet metal enclosure for fans located outdoors.

- D. Utility Fans, Vent Sets and Small Capacity Fans: Class 1 design, arc welded housing, spun intake cone. Applicable construction specifications, paragraphs A and C, for centrifugal fans shall apply for wheel diameters 12 inches and larger. Requirement for AMCA seal is waived for wheel diameters less than 12 inches and housings may be cast iron.

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.

3.2 PRE-OPERATION MAINTENANCE

- A. Grease bearings.
- B. Rotate impeller by hand and check for shifting during shipment and check all bolts, collars, and other parts for tightness.

3.3 START-UP AND INSTRUCTIONS

- A. Check vibration and correct as necessary for air balance work.
- B. After air balancing is complete and permanent sheaves are in place perform necessary field mechanical balancing to meet vibration tolerance in Section, NOISE AND VIBRATION CONTROL.

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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. Samples: Provide one typical air terminal unit for approval by the Resident Engineer. This unit will be returned to the Contractor after all similar units have been shipped and deemed acceptable at the job site.
- D. Certificates:
 - 1. Compliance with paragraph, QUALITY ASSURANCE.
 - 2. Compliance with specified standards.

- E. Operation and Maintenance Manuals: Submit in accordance with paragraph, INSTRUCTIONS, in Section 01 00 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning and Refrigeration Institute (AHRI)/(ARI):
880-08.....Air Terminals Addendum to ARI 888-98
incorporated into standard posted 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. Surgical Suite AHU: Provide copper fins and copper coils for all hot water reheat coils serving surgical suite.
 2. 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.
- 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.

2.3 AIR FLOW CONTROL VALVE (SV FOR SUPPLY AND EV FOR EXHAUST VALVE)

- A. Airflow control device shall be a venturi valve type air flow control valve.
- B. Pressure independent over a 150 Pa-750 Pa (0.6 inch WG - 3.0 inch WG) drop across valve.
- C. Volume control accurate to plus or minus 5% of airflow over an airflow turndown range of 16 to 1. No minimum entrance or exit duct diameters shall be required to ensure accuracy or pressure independence.
- D. Response time to change in command signal and duct static pressure within three seconds.
- E. 16 gauge spun aluminum valve body and control device with continuous welded seam and 316 stainless steel shaft and shaft support brackets. Pressure independent springs shall be stainless steel. Shaft bearing surfaces shall be Teflon or polyester.
- F. 16 ga. Spun aluminum width continuous welded seam valve body, control device, shaft, shaft support bracket, pivot arm and internal mounting link. The control device shall have a baked on corrosion resistant phenolic coating. The shaft shall have a Teflon coating and all shaft bearing surfaces shall be made of Teflon. The pressure independent springs shall be made of stainless steel. Supply valve shall be insulated with closed-cell polyethylene, 2 lb/ ft.³
- G. The airflow device shall have no exposed aluminum or stainless steel components. The shaft support brackets, pivot arm, internal mounting link, and pressure independent springs shall have a baked-on corrosion resistant phenolic coating. Internal nuts, bolts, and rivets shall be titanium or phenolic coated stainless steel.

I. Variable volume units:

1. Actuator to be factory mounted to the valve.
2. Closed loop control of airflow by way of flow feedback signal with less than 1 second response time.
3. Shaft positioned using direct potentiometer measurement to produce a linear factory calibrated feedback.

J. Certification:

1. Control device: factory calibrated to airflows detailed on plans using NIST traceable air stations and instrumentation having a combined accuracy of plus or minus 1% of signal over the entire range of measurement.
2. Electronic airflow control devices: further calibrated and their accuracy verified to plus or minus 5% of signal at a minimum of eight different airflows across the full operating range of the device.
3. All airflow control devices: individually marked with device specific, factory calibration data to include: tag number, serial number, model number, eight point characterization information (for electronic devices), and quality control inspection numbers.

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. See paragraph 3.3 for Intake/Exhaust exposed to high wind velocities. //
- E. 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 // except that all supply air outlets installed in operating rooms and Cystoscopy rooms (see Article 2.3C.3) shall be stainless steel. Use aluminum air outlets and inlets for facilities located in high-humidity areas. Exhaust air registers located in combination toilets and shower stalls shall be constructed from 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.
- d. Slot diffuser/plenum:
 - 1) Diffuser: Frame and support bars shall be constructed of heavy gauge extruded aluminum. Form slots or use adjustable pattern controllers, to provide stable, horizontal air flow pattern over a wide range of operating conditions.
 - 2) Galvanized steel boot lined with 13 mm (1/2 inch) thick fiberglass conforming to NFPA 90A and complying with UL 181 for erosion. The internal lining shall be factory-fabricated, anti-microbial, and non-friable.
 - 3) Provide inlet connection diameter equal to duct diameter shown on drawings or provide transition coupling if necessary. Inlet duct and plenum size shall be as recommended by the manufacturer.
 - 4) Maximum pressure drop at design flow rate: 37 Pa (0.15 inch W.G.)
- 2. Linear Bar Grilles and Diffusers: Extruded aluminum, manufacturer's standard finish, and positive holding concealed fasteners.
 - a. Margin Frame: Flat, 20 mm (3/4 inch) wide.
 - b. Bars: Minimum 5 mm (3/16 inch) wide by 20 mm (3/4 inch) deep, zero deflection unless otherwise shown. Bar spacing shall be a minimum of 3 mm (1/8 inch) on center. Reinforce bars on 450 mm (18 inch) center for sidewall units and on 150 mm (6 inch) center for units installed in floor or sills.
 - c. Provide opposed blade damper and equalizing or control grid where shown //.
- 3. Operating Room Air Distribution Devices:
 - a. Devices shall consist of a non-aspirating perforated panel center air supply providing downward airflow over the operating table and fixed nonadjustable multiple slot perimeter panels surrounding the operating table area to provide an air curtain which shall be projected outward from the operating table area at not less than a five degree angle nor more than a 15 degree angle. Velocity of air distribution at operating table height shall not exceed 12 m/min

(40 feet per minute) for the center supply or 15 m/min (50 feet per minute) for the air curtain. Perforated pressure plates shall be provided over the perimeter and center air distribution faces to equalize pressure and airflow throughout the system.

- b. All components of the system inside the operating room shall be fabricated of 1.0 mm (20 Gauge) thick 18-8 stainless steel (ASTM A167), No. 4 finish, and outside the operating room shall be of the manufacturer's standard aluminum finish. All distribution components and pressure plates shall be attached to the face panels at both the perimeter and center. The face panels shall be retained with 1/4 turn fasteners. Plenums shall be supplied by the manufacturer and shall be sized to permit them to be easily wiped out by hand with germicidal solution for sterilization purposes and all horizontal corners of the plenums shall have a minimum radius of 20 mm (3/4 inch). Connecting elbows shall be radialized and be sized to permit manual sterilization of the plenums.
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.

2.5 FILTER RETURN/EXHAUST GRILLE

- A. Provide grille with in stream 1-inch deep MERV 4 filter and removable face.
 - 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. Stainless Steel shall be No. 4 finish.
 - 2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 30 mm (1-1/4 inch) margin.
 - 3. Steel, Aluminum, or Stainless steel as scheduled.
 - 4. Standard face connected to a mounting frame with space for a throwaway filter. Hold face closed by a locking screw. Provide

retaining clips to hold filter in place. Provide fiberglass
throwaway filter.

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 INTAKE/ EXHAUST HOODS EXPOSED TO WIND VELOCITY

Provide additional support and bracing to all exposed ductwork installed on the roof or outside the building to withstand wind velocity of 145 km/h (90 mph) //or, in coastal areas, as defined in ASCE 7 Fig. 1.//

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 40 00
HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Air filters for heating, ventilating and air conditioning.
- B. Definitions: Refer to ASHRAE Standard 52.1 for definitions of face velocity, net effective filtering area, media velocity, resistance pressure drop), atmospheric dust spot efficiency and dust-holding capacity. ASHRAE Standard 52.1 measures arrestance, dust spot efficiency and dust holding capacity of filters.
- C. Refer to ASHRAE Standard 52.2 for definitions of MERV (Minimum Efficiency Reporting Value), PSE (Particle Size Efficiency) and particle size ranges for each MERV number. ASHRAE Standard 52.2 measures particle size efficiency (PSE).

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. Filter housing and racks: Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

1.3 QUALITY ASSURANCE

- A. Air Filter Performance Report for Extended Surface Filters:
 - 1. Submit a test report for each Grade of filter being offered. The report shall not be more than three (3) years old and prepared by using test equipment, method and duct section as specified by ASHRAE Standards 52.1 and 52.2 for type filter under test and acceptable to Resident Engineer, indicating that filters comply with the requirements of this specification. Test for 150 m/min (500 fpm) will be accepted for lower velocity rated filters provided the test report of an independent testing laboratory complies with all the requirements of this specification.
 - 2. Government Option: The Government at its option may take one of the filters for each different type submitted and run an independent test to determine if the filter meets the requirements of this specification. When the filter meets the requirements, the Government will pay for the test. When the filter does not meet the specification requirements, the manufacturer will be required to pay for the test and replace the filters with filters that will perform as required by the specifications.

3. Guarantee Performance: The manufacturer shall supply ASHRAE 52.2 test reports on each filter type submitted. Any filter supplied will be required to maintain the minimum efficiency shown on the ASHRAE Standard 52.2 report throughout the time the filter is in service. Within the first 6-12 weeks of service a filter may be pulled out of service and sent to an independent laboratory for ASHRAE Standard 52.2 testing for initial efficiency only. If this filter fails to meet the minimum level of efficiency shown in the previously submitted reports, the filter manufacturer/distributor shall take back all filters and refund the owner all monies paid for the filters, cost of installation, cost of freight and cost of testing.
- B. Filter Warranty for Extended Surface Filters: Guarantee the filters against leakage, blow-outs, and other deficiencies during their normal useful life, up to the time that the filter reaches the final pressure drop. Defective filters shall be replaced at no cost to the Government.
- C. Comply with UL Standard 586 for flame test.
- D. Nameplates: Each filter shall bear a label or name plate indicating manufacturer's name, filter size, rated efficiency and UL classification.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
1. Extended surface filters.
 2. Holding frames. Identify locations.
 3. Side access housings. Identify locations, verify insulated doors.
 4. HEPA filters.
 5. Magnehelic gages.
- C. Air Filter performance reports.
- D. Suppliers warranty.
- E. Field test results for HEPA filters as per paragraph 2.3.E.3.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE):
- 52.1-92R.....Gravimetric and Dust-Spot procedures for Testing
Air Cleaning Devices Used in General Ventilation
for Removing Particulate Matter

52.2-2007.....Method of Testing General Ventilation Air-
Cleaning Devices for Removal Efficiency by
Particle Size

C. American Society of Mechanical Engineers (ASME):

NQA-1-2008.....Quality Assurance Requirements for Nuclear
Facilities Applications

D. Underwriters Laboratories, Inc. (UL):

586;Amendment 20 March 2000 High-Efficiency, Particulate, Air Filter
Units

900;Revision 15 July 2009 Test Performance of Air Filter Units

PART 2 - PRODUCTS

2.1 REPLACEMENT FILTER ELEMENTS TO BE FURNISHED

- A. To allow temporary use of HVAC systems for testing and in accordance with Paragraph, TEMPORARY USE OF MECHANICAL AND ELECTRICAL SYSTEMS in Section 01 00 00, GENERAL REQUIREMENTS, provide one complete set of spare filters to the Resident Engineer.
- B. The Resident Engineer will direct whether these additional filters will either be installed as replacements for dirty units or turned over to VA for future use as replacements.

2.2 EXTENDED SURFACE AIR FILTERS

- A. Use factory assembled air filters of the extended surface type with supported or non-supported cartridges for removal of particulate matter in air conditioning, heating and ventilating systems. Filter units shall be of the extended surface type fabricated for disposal when the dust-load limit is reached as indicated by maximum (final) pressure drop.
- B. Filter Classification: UL approved Class 1 or Class 2 conforming to UL Standard 900.
- C. Filter Grades, Percent, Average ASHRAE Efficiency and Controlled Containment:

Table 2.2C

Filter Grades				
MERV Value ASHRAE 52.2	Application	Dust-Spot Efficiency ASHRAE 52.1	Particle Size	Thickness /Type
7	Pre-Filter	25 to 30%	3 to 10 Microns	50 mm (2-inch) Throwaway
8	Pre-Filter	30 to 35%	3 to 10 Microns	50 mm (2-inch)

				Throwaway
11	After-Filter	60 to 65%	1 to 3 Microns	150 mm (6-inch) Rigid Cartridge
13	After-Filter	80 to 90%	0.3 to 1 Micron	300 mm (12-inch) Rigid Cartridge
14	After-Filter	90 to 95%	0.3 to 1 Micron	300 mm (12-inch) Rigid Cartridge
17	Final-Filter	99.97%	0.3 Microns	HEPA - IEST A

D. Filter Media:

1. MERV 11, 13, and 14 Supported (Rigid Pleated) Type: Media shall be composed of high density glass fibers or other suitable fibers. Fastening methods used to maintain pleat shape, (metal backing or aluminum separators) shall be sealed in a proper enclosing frame to insure no air leakage for life of filter. Staples and stays are prohibited.
2. MERV 7 and 8 (Pleated) Type: Media shall be composed of synthetic/natural fibers. Media shall maintain uniform pleat shape and stability for proper air flow and maximum dust loading. The media frame shall be constructed of aluminized steel. Bond the pleated media pack on all four edges to insure no air leakage for the life of the filter. Staples and stays are prohibited.

E. Filter Efficiency and Arrestance: Efficiency and arrestance of filters shall be determined in accordance with ASHRAE Standard 52.1, and MERV value in accordance with ASHRAE Standard 52.2.

F. Maximum initial resistance, recommended change over pressure drop, and maximum recommended final resistance, PA (inches of water), for each filter cartridge when operated at 150 m/min (500 feet per minute) face velocity shall be as specified in Table 2.2.F:

Table 2.2.F

Filter Initial and Final Resistance			
	Initial Resistance	Maximum Recommended Change Over Pressure Drop	Maximum Final Resistance
MERV 7 (2-inch deep)	78 (0.31)	156 (0.62)	250 (1.00)
MERV 8 (2-inch deep)	95 (0.38)	190 (0.76)	250 (1.00)
MERV 11 (12-inch deep)	60 (0.24)	120 (0.48)	375 (1.50)
MERV 13 (12-inch deep)	125 (0.50)	250 (1.00)	375 (1.50)

MERV 14 (12-inch deep)	170 (0.68)	340 (1.36)	375 (1.50)
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G. Side Servicing Housings:

1. Minimum 1.6 mm (16 Gauge) galvanized steel, or aluminum, completely factory assembled with upstream and downstream flanges for connection into the duct system. Furnish housing length sufficient to provide for fully extended operating filter elements.
2. Access doors: Double wall insulated, located on one side of the housing; with continuous gasketing on the perimeter and positive locking devices. //Provide access doors on both sides only when required as shown on drawings.// Design doors to withstand a minimum positive/negative 1.0 kPa (4 inch WG) static pressure. Furnish access doors that are the full size of the housing.
3. Filter slide channels: Channels shall incorporate a positive-sealing gasket material to seal the top and bottom of the filter cartridge frames to prevent bypass. Provide factory installed gasketing to prevent leakage between cartridges, and between cartridges and doors.

SPEC WRITER NOTE: The use of Holding Frames is not permitted except in special applications (suitable for MERV 8 filters only).

H. Holding Frame System:

1. Minimum 1.6 mm (16 Gauge) galvanized steel, 100 mm (4 inches) deep, factory-supplied hardware necessary for field assembly, suitable for either upstream or downstream filter servicing. All members shall be cut to size and prepunched for easy assembly into modules of the size and capacity noted in the schedules.
2. The framing members shall be permanently gasketed to prevent the bypass of unfiltered air. If required, furnish suitable vertical support members to prevent deflection of horizontal members. The vertical support members shall not interfere with either the installation or operation of the filters.
3. The framing system shall incorporate a factory installed positive sealing device for each row of filters. This device shall allow for easy installation and removal of cartridges and shall insure the seal between the gasketed filter elements while the bank is in operation.//

I. Equipment Identification: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

2.3 HEPA FILTERS (MERV 17)

- A. High Efficiency Particulate Air (HEPA) filters shall be individually tested and certified to be 99.97 percent minimum efficient meeting minimum MERV value of 17 when handling 0.3 micron or smaller particles in accordance with DOP test method. Filters shall be factory scanned. The DOP efficiency along with filter serial number and name of manufacturer shall be marked on the filter. HEPA filter shall have a maximum initial filter resistance of 250 Pa (1 inch W.G.) and a maximum recommended final resistance of 500 Pa (2 inch WG) with operate when operating at 125 m/s (250 ft/min) face velocity. The Maximum recommended change over pressure drop shall be no greater than twice the actual initial pressure drop.
- B. Filter media: Factory constructed by pleating a continuous sheet of media into closely spaced pleats with kraft or aluminum separators. Sealer shall be self-extinguishing.
- C. Enclosing frame shall be 16 gauge galvanized steel. Provide pre-filters in the same housing with a separate removal assembly that operates independently from the HEPA filters.

DESIGNER'S NOTE: 2-inch thick MERV 8 pre-filters are required for the exhaust application only. Where HEPA filters are used as Final-Filters in the supply air systems, do not use 2-inch thick pre-filters.

- D. Pre-filter: MERV 7 and 8, 2 inches deep. See Paragraph 2.2.

DESIGNER'S NOTE: Bag-In/Bag-Out housings shall be used for isolation rooms and other applications involving contagious diseases. Bag-In/Bag-Out housings are not required for the HEPA filters used as final filters.

- E. Bag-In/Bag-Out Housing for HEPA Filters:
 - 1. Housing shall be fabricated of 15 gauge type 304 stainless steel.
 - 2. Housing shall be equipped with weather covers, drilled face flanges and factory mounted Magnehelic gauges with Petcocks housed in stainless steel brackets.
 - 3. Housing shall be pressure tested in factory for high quality to withstand a positive or negative pressure of 10 inch WG. // If HEPA filters are specified for TB Isolation Rooms, perform a quantitative leakage and filter performance DOP (Diocetyl Phthalate Penetration) field test in addition to factory test at the initial installation, in the presence of the factory representative, recommended by the Center for Disease Control (CDC).

4. Housing shall incorporate a spring loaded clamping mechanism that is operated from outside and which is capable of exerting a 5340 N. (1,200 lb) sealing force across the top and bottom of each filter.
5. Housing shall have a bagging ring around the access port, sealed by a removable, gasketed access door. The bagging ring shall have two (2) continuous ribs to secure the plastic change-out bag and be hemmed on its outer edge to prevent the bag from tearing.
6. One 8 mil thick PVC change-out bag shall be supplied for each access door. The bag shall include approximately 300 mm (12 inches) of transparent PVC at the open end and three glove sleeves built into the body to assist in filter change-out. Bag-In/Bag-Out housings shall be manufactured under a quality assurance program that addresses the requirements of ASME NQA1, "Quality Assurance Requirements for Nuclear Facilities Applications."
7. Comply with U.L. Standard 586.

F. HEPA Filter 2 stage side access housing. Provide to accept 12-inch thick filter and 2-inch thick pre-filter. Refer to Section 2.2.H.

2.4 CARBON FILTERS

- A. Factory fabricated activated Carbon filters for odor control with multiple cells of porous activated carbon media.
- B. Media impregnated with a high density of granular 60 percent minimum activity.
- C. Frame constructed of high strength, moisture resistant and constructed to prevent air leakage and spilling of media.
- D. Initial resistance of 2.50 m/s (500 FPM) air velocity not to exceed 180 Pa (0.76 inch WG) with rated average arrestance of 80 percent.
- E. Filter performance data shall conform to ASHRAE Standard 52.1 and pads classified as Class 2 as per testing performed according to UL Standard 900.
- F. Provide side service housing containing pre-filters, carbon filters and after-filters (outside) rated to 1495 Pa (6.0 inch WG).
- G. Nominal Dimensions: 305 mm or 610 mm (12 inches or 24 inches) high by 610 mm (24 inches) wide. 1 m (3'-4") (maximum) depth.

2.5 INSTRUMENTATION

- A. Magnehelic Differential Pressure Filter Gages: Nominal 100 mm (four inch) diameter, zero to 500 Pa (zero to two inch water gage), three inch for HEPA) range, //except for MERV 17 HEPA Final Filters, where the range shall be zero to 750 Pa (zero to three inch water gage)// Gauges shall be flush-mounted in aluminum panel board, complete with static

tips, copper or aluminum tubing, and accessory items to provide zero adjustment.

- B. DDC static (differential) air pressure measuring station. Refer to Specification Section 23 09 23 DIRECT DIGITAL CONTROL SYSTEM FOR HVAC
- C. Provide one DDC sensor across each extended surface filter. Provide Petcocks for each gauge or sensor.
- D. Provide one common filter gauge for two-stage filter banks with isolation valves to allow differential pressure measurement.

2.6 HVAC EQUIPMENT FACTORY FILTERS

- A. Manufacturer standard filters within fabricated packaged equipment should be specified with the equipment and should adhere to industry standard.
- B. Cleanable filters are not permitted.
- C. Automatic Roll Type filters are not permitted.

2.7 FILTER RETURN GRILLES

- A. Refer to Section 23 37 00 AIR OUTLETS AND INLETS.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install supports, filters and gages in accordance with manufacturer's instructions.
- B. Label clearly with words "Contaminated Air" on exhaust ducts leading to the HEPA filter housing.

3.2 START-UP AND TEMPORARY USE

- A. Clean and vacuum air handling units and plenums prior to starting air handling systems.
- B. Install or deliver replacement filter units as directed by the Resident Engineer.

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SECTION 23 43 10
VARIABLE FREQUENCY DRIVES

PART 1- GENERAL

1.1 DESCRIPTION

- A. This section specifies variable frequency & drives and remotely installed isolation transformers.
- B. Materials, equipment, fabrication, installation and tests, in conformity with applicable codes and authorities having jurisdiction, for variable frequency drives. (VFD's)

1.2 RELATED WORK

- A. Section 23 05 12; GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT
- B. Section 23 73 00; INDOOR CENTRAL STATION AIR HANDLING UNITS
- C. Section 23 09 23; DIRECT DIGITAL CONTROL SYSTEM FOR HVAC
- D. Section 23 74 14; TESTING, ADJUSTING AND BALANCING.

1.3 QUALITY ASSURANCE

- A. Refer to Section, 23 05 12; GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT

1.4 SUBMITTALS

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

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
 - 00-A-372E.....Air-Conditioners (Electric Motor Driven Self-contained Shore Use)
 - 00-A-373C.....Air-Conditioners, Single Package Type.
 - 00-A-374B.....Air-Conditioners With Remote Condensing Units or Remote Condensing Units.
- c. Military Specifications (Mil. Specs.):
 - MIL-H22547C.....Heat Pumps, Heating and Cooling (Unitary), (8400 to 300,000 BTU)
 - MIL-P-26915B.....Primer Coating, Zinc Dust Pigmented, For Steel Surfaces

- D. Air-Conditioning and Refrigeration Institute (ARI)
Standards:
- 210/240-89.....Unitary Air-conditioning and Air Source
Heat Pump Equipment.
- 270-84 Sound Rating of Outdoor Unitary
Equipment.
- 310-90 Packaged Terminal Air-Conditioners.
- 320-86 Water-source Heat Pumps
- 340-86 Commercial and Industrial Unitary Heat
Pump Equipment.
- 360-86 Commercial and Industrial Unitary Air-
Conditioning Equipment.
- 380-90.....Packaged Terminal Heat Pumps.
- 520-90.....Positive Displacement Refrigerant
Compressors, Compressor Units and
Condensing Units.
- ARI-DCAACP.....Directory of Applied Air Conditioning
Products.
- E. Air Movement and Control Association (AMCA):
- 210-85 Laboratory Methods of Testing Fans for
Rating
- 410-90 Recommended Safety Practices for Air
Moving Devices.
- F. American National Standards Institute (ANSI):
- S12.31-90.....Precision Methods for the Determination
of Sound Power Levels of Broad-Band Noise
Sources in Reverberation Rooms.
- G. American Society of Heating, Refrigerating, and Air-
Conditioning Engineers Inc. (ASHRAE), Inc. Publications:
- 1988 Equipment Handbook
1989 Systems Handbook
- E. American Society of Testing and Materials (ASTM):
- B117-90.....Standard Method of Salt spray (Fog)
Testing.
- F. National Electrical Manufacturer's Association (NEMA):
- MG-1-93.....Motors and Generators.

ICS-1-R90.....Industrial Controls and Systems

G. National Fire Protection Association (NFPA) Publications:

90A-1996.....Standard for the Installation of Air-
Conditioning and Ventilating Systems.

1.6 QUALIFICATIONS:

- A. Manufacturer: Company specializing in manufacture of variable frequency drives and their accessories, with minimum ten years documented product development, testing and manufacturing experience in the horsepower range required.

1.7 MANUFACTURERS:

1. Variable Frequency Drives:
a. Toshiba.
b. Robicon.
c. Allen-Bradley.

PART 2 - PRODUCTS

2.1 VARIABLE FREQUEMNCY DRIVES

A. General:

1. Motors shall be provided with U.L. Listed variable frequency drive (VFD) control systems.
2. Motors shall be provided with a microprocessor based, pulse width modulated (PWM) variable frequency drive (VFD) control systems as specified or noted.
3. The adjustable frequency ac motor drive shall be designed to convert he 60 Hz input power to adjustable frequency output power. The output frequency and voltage of the drive shall be adjustable such that a constant volts/Hz ratio is determined from the design parameters of the driven motor.
4. Drive shall be capable of operating any standard squirrel cage induction motor with load rating within the capacity of the drive. At any time in the future, it shall be possible to substitute a new or rewound motor in the field without requiring modification of the drive.
5. For retrofit project, drive shall be compatible with existing motor.

6. For maintenance purposes, drive shall be capable of starting, stopping and running with stable operation with the motor completely disconnected (no load).

B. Features:

1. Drive enclosure shall be a NEMA Type 1 or equivalent, wall or floor mounted, metal cabinet with hinged front access door(s), filtered ventilation system (if required), and controls that are mounted, wired and tested.
2. Fused, interlocked disconnect switch or input line circuit breaker, externally operated interlocked with enclosure door. Short circuit interrupting rating of 200,000 amps.
3. Internal 115 VAC control power circuit with transformer and primary and secondary protective fuses.
4. Two normally open and two normally closed contacts from run relay, wired to terminal for customer use. Contactors to enable control of drive from a central control system for start/stop and load shed operation through remote speed reset.
5. Controlled acceleration and deceleration, separately adjustable, shall be provided from 0.5 to 200 seconds with torque limit override acceleration protection and regeneration protection during deceleration.
6. Drive shall automatically adjust the volts/Hz ratio to the motor in proportion to its load without changing speed in order to conserve the maximum amount of energy.
7. Separately adjustable maximum and minimum frequency limits shall be provided.
8. Low frequency/low voltage start with linearly adjustable ramp up to preselected speed.
9. All components shall be accessible from the cabinet door for service. Drive must be designed for side-by-side, back-to-back and against-the-wall installation.
11. Door mounted ac ammeter or percent load meter.
12. Door mounted speed control and speed indicator.
13. Door mounted voltmeter.
14. Hand/off/auto switch/stop pushbuttons or switches.

- a. In the "hand" position, the speed is controlled by the door mounted speed control and the start/stop commands are controlled by the door mounted start/stop pushbuttons or switches.
 - b. In the "off" position, the drive cannot be started.
 - c. In the "auto" position, the speed is controlled by a remote electronic signal and the drive can receive only a remote start command (momentary contact closure). The stop command in the auto position can be either remote or from the door mounted stop pushbutton or switch (to ensure maximum safety).
 - d. To facilitate equipment setup, the drive shall not undergo complete shutdown when moving the selector switch from the hand position to the auto position.
- 14. Drive fault alarm contact for remote indication.
 - 15. Automatic reset of drive to receive start command after any normal shutdown, including power outages.
 - 16. Remote electrical signal for speed control (to be coordinated with control contractor).
 - 17. Critical speed rejection circuit.
 - 18. Drive shall be constructed with integral protection against all normal transients and surges in the incoming power line, any grounding or disconnecting of the output power line, and any interruption or runaway of the incoming speed reference signal. Protection is defined as a normal shutdown or return to original speed with no component damage.
 - 19. Drive shall protect itself against all phase-to-phase and phase-to-ground faults.
 - 20. Drive shall protect itself against any removal of load.
 - 21. Drive shall employ adjustable torque limit control to override the speed command and decrease the frequency while maintaining the correct volts/Hz ratio whenever the load level surpasses the drive design level.
 - 22. Drive shall protect itself against single-phasing and power outages and shall be insensitive to input phase rotation.

23. Drive shall start into a spinning motor or shut down with no component damage.
24. Drive shall ride through any input power dip of three cycles or less.
25. Drive shall go through an orderly shutdown when the incoming voltage low limit is surpassed.
26. Instantaneous overcurrent trip (IOT) shall continuously monitor pack currents. It shall provide instantaneous shutdown without component failure when high limit setting is surpassed.
27. Torque limit shall be settable from 50 to 100 percent of full drive rating on variable torque loads. When torque limit engages, the output frequency is steadily reduced until the load reduces to the design capacity. At that point, the speed will stabilize. If the load reduces further, the drive shall re-accelerate to the preset speed.
28. Manual bypass starter complete with operator devices, including Drive/Off/Bypass selector and bypass indicating light. Start/Stop pushbuttons or switch to operate in bypass mode. The bypass circuit shall consist of two contactors, motor overload and two circuit breakers; (one main circuit breaker and one VFD circuit breaker, to enable isolation of VFD).
29. UL Listed, nonlinear isolation transformer to prevent noise and harmonic feedback to electrical system. Shall be mounted in NEMA 1 enclosure and be of dry type construction with Class H insulation. Transformer shall be provided by variable frequency drive manufacturer to match performance of variable frequency drive(s).
30. Drive shall include line reactors to reduce line noise generated by the drive. The drive manufacturer shall prepare and submit calculation to estimate harmonic distortion levels prior to the installation. The line harmonics and notching generated by the drive shall not exceed the levels for a general system as stated in the Institute of Electrical and Electronics Engineers Standard 519 Guide for Harmonic Control of Static Power. Converters to a maximum of 5% Total Harmonic Distortion (THD) for voltage and 8% THD for current at Point of Common Coupling (PPC), Line notch area shall not exceed 22,800 (V/S) and minimum 5 (Rho) line notch depth. The manufacturer shall provide additional line reactors to ensure that this standard is met as necessary.
32. Drive shall be designed to meet the guidelines regarding emission of Radio Frequency and

Electromagnetic Interference (RFI/EMI) set by FCC Class A guidelines through the use of tuned line filter, adjusted as required to prevent electrical power supply system. The unit shall comply with the FCC Class A noise emissions standard. In addition, the drive manufacturer must provide lab test results from and independent test laboratory showing this compliance.

33. A digital diagnostic system, which monitors its own control functions and displays faults and operating conditions.
34. Operating conditions:
 - a. Line voltage variations: +10%, -5%.
 - b. Line frequency variations: 2 Hz.
 - c. Overload capability of up to 130 percent of full drive rating for variable torque loads.
 - d. Ambient temperature: 0°C to 40°C.
 - e. Maximum altitude limit: 3,300 ft.
 - f. Maximum humidity: 95 percent (non-condensing).
 - g. Efficiency in excess of 95 percent at full load/full speed and in excess of 80% at half speed on a variable torque load (cubic load).

35. VFD Communications:

A. Serial Communications

1. The VFD shall have an EIA-485 port as standard. The standard protocol shall be BACnet.
2. Each individual drive shall have the protocol in the base VFD.
3. The use of third party gateways and multiplexers is not acceptable.
4. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet).
5. Use of non-certified protocols is not allowed.

B. Connections

- The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps.
- The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed.
- The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC).
- The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

- a. Data Sharing - Read Property - B.
- b. Data Sharing - Write Property - B.
- c. Device Management - Dynamic Device Binding (Who-Is; I-AM).
- d. Device Management - Dynamic Object Binding (Who-Has; I-Have).
- e. Device Management - Communication Control - B.

1. Training:

Factory representative shall provide on-site training of operating personnel after the system is fully operational.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Handle and install units and accessories in accordance with the manufacturer's printed instructions.

3.2 TESTS

- A. Perform tests and make report in accordance with Sections, BASIC METHODS AND REQUIREMENTS and TESTING, ADJUSTING AND BALANCING

- - - E N D - - -

SECTION-23 73 00
INDOOR CENTRAL STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Air handling units for the required HVAC functions. Air handling unit shall be the modular type as indicated on drawings.
- B. Definitions:
 - 1. Factory fabricated air handling unit: A unit consisting of a fan section and other required components, referred to as Central Station Air Handling Unit by ARI Standard 430. Units may be field or factory assembled.

1.2 RELATED WORK

- A. Section 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT
- B. Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT
- C. Section 23 73 10, HEATING AND COOLING COILS.
- D. Section 23 40 10, AIR FILTERS.

1.3 QUALITY ASSURANCE

- A. Refer to Article, Quality Assurance, in Section, 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC & STEAM GENERATION EQUIPMENT
- B. Factory fabricated air handling units shall be tested, rated and certified in accordance with ARI Standard 430 and bear the ARI certification label.
- C. Performance Criteria:
 - 1. The fan schedule shows CFM and design static pressure. Scheduled fan motors, 1/2 horsepower and larger, have been sized for design CFM at 110 percent design static pressure, but not to exceed 3/4-inch additional pressure.
 - 2. Provide fans and motors capable of stable operation at design conditions and at 110 percent pressure as stated above.
 - 3. Lower than design pressure drop of approved individual components may allow use of a smaller fan motor and still provide the safety factor. When submitted as a deviation a smaller motor may be approved in the interest of energy conservation.
 - 4. Select fan operating points as follows:
 - a. Forward curved fans: Right hand side of peak pressure point. Fans selected with operating point to the left of the peak pressure point will be acceptable when the manufacturer certifies that operation will be stable and satisfactory.

1.4 SUBMITTALS

In accordance with Section 01 33 23, SAMPLE AND SHOP DRAWINGS, furnish the following:

- A. Manufacturer's Literature and Data:
 - 1. Factory fabricated air handling unit components:
 - a. Include coils, and motors and drives with units.
 - b. Sound power levels.
 - c. Fan curves showing CFM static pressure, efficiency, and horsepower for design point of operation and at 110 percent of design static pressure.
- B. Maintenance and operating manuals in accordance with Section 01 01 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

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

- A. Federal Specifications (Fed. Spec.):
HH-I-545(1) 1974.....Insulation, Thermal and Acoustical (Mineral Fiber, Duct Lining Material)
- B. Military Specifications (Mil. Spec.):
MIL-P-21035.....Paint, High Zinc Dust Content, Galvanizing Repair
- C. Air-Conditioning and Refrigeration Institute (ARI):
430-78Standard for Central Station Air Handling Units. Directory of Certified Applied Air Conditioning Products
- D. Air Moving and Conditioning Association (AMCA):
99-83.....Standards Handbook
300-67Test Code for Sound Rating
301-76Methods for Calculating Fan Sound Ratings from Laboratory Test Data
- E. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
68-78.....Method of Testing In-Duct Sound Power Measurement Procedure for Fans
- F. American Society for Testing and Materials (ASTM):
B117-85.....Salt Spray (Fog) Testing

C423-77Sound Absorption and Sound Absorption
Coefficients by the Reverberation Room Method

D1735-62.....Water Fog Testing of Organic Coatings

D3359-83.....Measuring Adhesion by Tape Test

E84-81*.....Surface Burning Characteristics of Building
Materials

E90-81*.....Airborne-Sound Transmission Loss of Building
Partitions, Laboratory Measurement

E413-73*.....Sound Transmission Class, Classification for
Determination

G23-81.....Operating Light-Exposure Apparatus

G. Anti-Friction Bearing Manufacturer's Association, Inc. (AFBMA):

9-1978.....Load Ratings and Fatigue Life for Ball Bearings

H. National Fire Protection Association (NFPA):

90A-1985.....Installation of Air Conditioning and
Ventilating Systems

PART 2 - PRODUCTS

2.1 FACTORY FABRICATED AIR HANDLING UNIT

A. Standards and Certification Compliance:

1. Standards: ARI 430.
2. Certification: ARI Directory of Certified Applied Air
Conditioning Products.
3. Operating limits: AMCA 99 (Class A, B, C, as defined by
Standard 1401-66).
4. Sound power level ratings: AMCA 300 and 301, or ASHRAE 68.

B. Casings: 18 gage steel, or equivalent strength construction,
fastened to a steel support frame. Extend support frame as necessary
so that support framing members do not block access. Provide
reinforced support points for hanging the unit.

1. All steel shall be mill-galvanized, or phosphatized and coated
inside and out 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 G23 weathermeter.
2. Coil and fan casings shall have removable panels for servicing
or replacement of components. These removable panels are not
to be construed as inspection or access panels.
 - a. Unit inspection doors shall be a minimum of 6 inches high
by 6 inches wide in each end of fan sections and in other

locations shown on the drawings. Doors shall be double wall, insulated, hinged and provided with heavy duty latches. Doors shall be designed to open against the unit static pressure unless properly safety latched and gasketed to prevent air leakage.

- b. Unit access doors shall be provided for all sections where maintenance is required, and as shown on drawings. Access doors shall be double wall, insulated, hinged and provided with heavy duty latches. Minimum door width shall be 12 inches. Door height shall be full height as determined by unit casing. Doors shall be hinged to open against fan operating pressure unless properly safety latched and gasketed to prevent air leakage.
 - c. Airway access sections with hinged and latched access doors shall be provided. Sections shall be provided with access doors on each side unless otherwise indicated on drawings. Access sections located downstream of the cooling coil shall be insulated as specified for unit casing.
- C. Fan: Double width, double inlet centrifugal type, factory balanced. The vibration tolerance is specified in Section, NOISE AND VIBRATION CONTROL. Provide self-aligning, pillow block or flanged type, regreaseable, ball type bearings selected for 200,000 hours average life, per AFBMA Standard 9. Extend grease lines for interior fan or motor bearings to the outside of the casing. Provide adjustable motor mounting base, with locking device, and drive guard. Internally mounted motors and drives do not require a separate drive guard. Provide internal spring isolators with minimum 2" deflection for fan, motor and drive assembly. Isolators to be seismic restraining type.
- 1. Fan motor and drive: Furnish from the factory with the air handling unit. Refer to Section, BASIC METHODS AND REQUIREMENTS (MECHANICAL), for motor and drive specifications.
 - 2. Flexible connection: Provide for units with internally mounted motor and drive.
- D. Coils: Section, 23 73 10 INDOOR CENTRAL AIR HANDLING HEATING AND COOLING COILS.
- E. Stainless Steel Condensate Drain Pan: Extend under cooling coil and header. Provide outlet connection. Insulate pan with not less than 1/2-inch thick, rigid, water impervious insulation of sprayed or foamed-in-place type. Insulation adhesive and inner coating shall comply with NFPA 90A flame spread and smoke generation requirements. Manufacturer's standard double-bottom insulated pan is acceptable.
- F. Filter Sections: Provide for type and arrangement of filters shown. Pre filter section with tracks for angled 2 inch deep 30% filters. Provide magnahelic gages across filter section. Filter section to be integral part of air handling unit.
- G. Internal Insulation:
- 1. Materials shall meet NFPA 90A flame spread and smoke generation requirements.

2. Isocyanurate rigid foam insulation: Five-eighths inch minimum thickness, closed cell, $K = 0.11$ at 75 degrees F mean temperature, density 1.9 PCF, enclosed between two faces of 2 mil thick smooth aluminum foil. Insulation shall be applied with mechanical fasteners. Seal edges and butt joints with 2-inch wide, mil thick aluminum tape. This insulation is also acceptable in lieu of external insulation in units without final filter in supply air ductwork downstream of unit. On access doors this insulation shall be considered equal to double-skin insulated doors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify that coils, filters, motors, drives and other components are matched with the proper air handling unit.
- B. Assemble air handling unit components following manufacturer's instructions for handling, testing and operation. Assemble air handling unit sections on site as required to fit into locations shown. Provide extensions of unit base rail as indicated. Repair damaged galvanized areas, and paint in accordance with Mil. Spec. MIL-P-21035.
- C. Vacuum clean interior of air handling units prior to operation.
- D. Repair air leaks from or into casing that can be heard or felt during normal operation.
- E. Perform field mechanical (vibration) balancing in accordance with Section, BASIC METHODS AND REQUIREMENTS (MECHANICAL).
- F. Provide work to get air handling units into interstitial space where required. Installation of the air handling units may require the following:
 1. Disassembly and reassembly of air handling unit sections.
 2. Breaking out and repair of existing walls, floors and framing. Restore conditions of existing facilities immediately following air handling unit installation. Restored conditions shall match existing conditions.
 3. Removal and replacement of slabs, beams, service platforms and other structural components.
 4. Disassembly and reassembly of air handling unit base rail.
 5. Provide additional work as required for installation.

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SECTION 23 81 23
COMPUTER-ROOM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies process cooling split systems air conditioning unit.
- B. Definitions:
 - 1. Energy Efficiency Ratio (EER): A ratio calculated by dividing the cooling capacity in Btuh by the power input in watts at any given set of rating conditions, expressed in Watts (Btu/h) per watt.
 - 2. Coefficient of Performance (COP): A ratio calculated by dividing the change in heating or cooling capacity (Btu/h) to the energy consumed by the system (kW), expressed in Btu/kWh.
 - 3. Unitary (AHRI): Consists of one or more factory-made assemblies, which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function.
 - 4. CRAC Units: Computer Room Air Conditioning Units.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: Requirements for pre-test of equipment.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic requirements for non-structural equipment.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- D. Section 23 21 23, HYDRONIC PUMPS: Requirements for pumping equipment.
- E. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT: Requirements for vibration isolators and room noise level.
- F. Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION: Requirements and for ducts and piping insulation.
- G. Section 23 23 00, REFRIGERANT PIPING: Requirements for field refrigerant piping.
- H. Section 23 21 13, HYDRONIC PIPING.
- I. Section 23 31 00, HVAC DUCTS and CASINGS: Requirements for sheet metal ducts and fittings.
- J. Section 23 40 00, HVAC AIR CLEANING DEVICES: Requirements for filters including efficiency.
- K. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Requirements for controls and instrumentation.

- L. Section 23 05 93: TESTING, ADJUSTING, and BALANCING FOR HVAC:
Requirements for testing, adjusting and balancing of HVAC system.
- M. Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS: Requirements for
commissioning, systems readiness checklists, and training.

1.3 QUALITY ASSURANCE

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

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, rated capacities (at design indoor and outdoor conditions), EER/COP, operating characteristics, required specialties and accessories. Submit published catalog selection data showing equipment ratings and compliance with required sensible ratio.
 - 1. Indoor Air Conditioning Unit
 - 2. Glycol Pump Package
 - 3. Dry Cooler
 - 4. Air Cooled Condensing Unit
- C. Submit detailed equipment assemblies with dimensions, operating weights, required clearances.
- D. Submit wiring diagrams for power, alarm and controls.
- E. Certification: Submit, simultaneously with shop drawings, a proof of certification:
- F. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

1.5 GUARANTEE

The unit shall be guaranteed against all mechanical defects in material, parts or workmanship and shall be repaired or replaced at the Contractor's expense within the period of one year from final acceptance. Contractor shall adhere to a four hour service response time to troubles during the guarantee period.

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. Federal Specifications (Fed Spec):
 - 00-A-374C-95.....Air-Conditioners with Remote Condensing Units or Remote Air-cooled and Water-Cooled Condenser Units, Unitary

- TT-C-490D-93.....Cleaning Methods for Ferrous Surfaces and
Pretreatments for Organic Coatings
- C. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standards:
- 210/240-08.....Performance Rating of Unitary Air-Conditioning
and Air-Source Heat Pump Equipment
- 340/360-07.....Performance Rating of Commercial and Industrial
Unitary Air Conditioning and Heat Pump Equipment
- 410-01.....Forced-Circulation Air-Cooling and Air-Heating
Coils
- 460-2005.....Performance Rating of Remote Mechanical-Draft
Air-Cooled Refrigerant Condensers
- 520-04.....Performance Rating of Positive Displacement
Condensing Units
- AHRI-DCPP.....Directory of Certified Product Performance -
Applied Directory of Certified Products
- D. Air Movement and Control Association (AMCA):
- 210-07.....Laboratory Methods of Testing Fans for Certified
Aerodynamic Performance Rating (ANSI)
- 410-96.....Recommended Safety Practices for Users and
Installers of Industrial and Commercial Fans
- E. American Society of Heating, Refrigerating, and Air-Conditioning
Engineers Inc. (ASHRAE):
- 15-10.....Safety Standard for Refrigeration Systems (ANSI)
- 90.1-10.....Energy Standard for Buildings except Low-Rise
Residential Buildings (ANSI Approved; IESNA Co-
sponsored)
- 2008 Handbook.....HVAC Systems and Equipment
- 2010 Handbook.....Refrigeration
- 52.1-92.....Gravimetric and Dust-Spot Procedures for Testing
Air-Cleaning Devices used in General Ventilation
for Removing Particulate Matter
- F. American Society of Testing and Materials (ASTM):
- B117-09.....Standard Practice for Operating Salt Spray (Fog)
Apparatus
- G. National Electrical Manufacturer's Association (NEMA):
- MG 1-09 (R2010).....Motors and Generators (ANSI)
- H. National Fire Protection Association (NFPA) Publications:
- 70-11.....National Electrical Code
- 90A-09.....Standard for the Installation of Air-
Conditioning and Ventilating Systems

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED UNITS

- A. Description: Packaged, factory assembled, prewired, and prepiped; consisting of cabinet, fans, filters, humidifier, and controls.
- B. Cabinet and Frame: Welded steel, braced for rigidity, and supporting compressors and other mechanical equipment and fittings.
- C. Doors and Access Panels: Galvanized steel with polyurethane gaskets, hinges, and concealed fastening devices.
- D. Insulation: Thermally and acoustically insulate cabinet interior with - 25-mm (1-inch) thick 24 kg/m³ (1.5 lb /ft³) high-density mineral fiber duct liner coated on airstream side.
- E. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
- F. Finish of Exterior Surfaces: Baked-on, textured vinyl enamel; color to match computer equipment.
- G. Floor Stand: Welded tubular steel, with adjustable legs and vibration isolation pads.
- H. Supply-Air Fan(s): Double-inlet, forward-curved centrifugal or plenum fans(s, statically and dynamically balanced.
- I. Drive:
 - 1. Forward-Curved Centrifugal Fan(s): V-belt, with steel shaft with self-aligning ball bearings and cast-iron or steel sheaves, variable and adjustable-pitch motor sheave, minimum of two matched belts, with drive rated at a minimum of two times the nameplate rating of motor.//
 - 2. Plenum Fans: Direct-drive, Arrangement 4, variable-speed drive fan(s) with aluminum wheels; with multiple fans, the number of fans shall not exceed four.
- J. Compressors: Hermetic scroll; with oil strainer, internal motor overload protection, resilient suspension system, crankcase heater, manual-reset high-pressure switch, and pump-down low-pressure switch. Compressors shall have multiple stages of cooling as listed on the drawing equipment schedule.
- K. Refrigeration Circuits: Two; each with hot-gas mufflers, thermal-expansion valve with external equalizer, liquid-line solenoid valve, liquid-line filter-dryer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
- L. Refrigerant: R-410A unless otherwise indicated.

- M. Refrigerant Evaporator Coil: Alternate-row or split-face-circuit, direct-expansion coil of seamless copper tubes expanded into aluminum fins.
1. Coil assembly shall be mounted over stainless-steel drain pan complying with ASHRAE 62.1-2010 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- N. Remote Air-Cooled Refrigerant Condenser: Corrosion-resistant cabinet, copper-tube copper-fins coils arranged for two circuits, multiple direct-drive propeller fans with permanently lubricated ball bearings, and single-phase motors with internal overload protection and integral electric control panel and disconnect switch. Control capacity by cycling fans three-way refrigerant bypass with receiver and isolation valve.
- O. Heating Coil:
1. Electric-Resistance Heating Coil: Enclosed finned-tube electric elements arranged for //minimum of three stages//SCR control//, with thermal safety switches, manual-reset overload protection, and branch-circuit over current protection.
 2. Refrigerant Heating Coil: Hot-gas coil of seamless copper tubes expanded into aluminum fins with three-way solenoid valve on first-stage refrigerant circuit.
- P. Filter Extended-Surface, Disposable, Panel type: Pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded-wire grid; enclosed in cardboard frame with 50-mm (2-inch) thick, disposable, glass-fiber prefilter.
1. Thickness: 50 mm (2 inches).
 2. Initial Resistance: 75 Pa (0.3 inches wg).
 3. Recommended Changeover Resistance: 150 Pa (0.6 inches wg).
 4. Arrestance: 90 percent according to ASHRAE 52.1.
 5. MERV Rating: 7, according to ASHRAE 52.2.
- U. Humidifier:
1. Infrared Humidifier: High-intensity quartz lamps mounted above stainless-steel evaporator pan, serviceable without disconnecting water, drain, or electrical connections; prepiped and using condensate water from cooling coils with stainless-steel or brass float-valve mechanism; located in bypass airstream; with flush-cycle timer and solenoid drain valve.
 2. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve

incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.

3. Control: Fully modulating to provide gradual 0 to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.

5. Drain Cycle: Field-adjustable drain duration and drain interval.

V. Controls:

1. Integral Electrical Controls: Unit-mounted electrical enclosure with piano-hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control-circuit transformer.

a. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

2. Electronic-Control System: Solid state, with start button, stop button, temporary loss of power indicator, manual-reset circuit breakers, temperature control, humidity control, and monitor panel.

W. Microprocessor-Control System: Continuously monitors operation of process cooling system; continuously displays room temperature and room relative humidity; sounds alarm on system malfunction and simultaneously displays problem. If more than one malfunction occurs, system displays fault in sequence with room temperature and continues to display fault when malfunction is cleared until system is reset.

X. Malfunctions:

1. Power loss, loss of airflow, clogged air filter, high room temperature, and low room temperature.

2. High humidity.

3. Low humidity.

4. Smoke/fire, water under floor supply fan overload, compressor No. 1, overload compressor No. 1 low pressure.

5. Compressor No. 1, high pressure.

6. Compressor No. 2 overload.

7. Compressor No. 2, low pressure.

8. Compressor No. 2 high pressure.

9. Digital Display:

a. Control power on.

b. Humidifying.

c. Dehumidifying

d. Compressor No. 1 - Operating.

e. Compressor No. 2 operating.

- f. Heat operating.
- g. Economy cooling.
- 10. Push buttons shall stop and start process cooling system, silence audible alarm, test indicators, and display room's relative humidity.
- Y. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display unit status and alarms via an open protocol BACnet data interface.
- Z. Compatible with // ASHRAE 135 (BACnet) Industry-accepted, open-protocol for communication interface with the BAS shall enable the BAS operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the BAS.

2.2 CEILING-MOUNTED UNITS

- A. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls; for horizontal ceiling mounting to fit T-bar ceiling opening of 610 by 1220 mm (24 by 48 inches).
- B. Cabinet: Galvanized steel with baked-enamel finish, insulated with 13-mm (1/2-inch) thick duct liner.
- C. Integral factory-supplied supply and return grille to fit ceiling grid kit of 610 by 1220 mm (24 by 48 inches), with filter.
- D. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2010.
- E. Supply-Air Fan:
 - 1. Forward-Curved, Centrifugal Fan: Provide with directly-driven fan with two-speed motor.
 - 2. Plenum Fans: Direct-drive, Arrangement 4, variable-speed drive fan(s) with aluminum wheels; with multiple fans, the number of fans shall not exceed four.
- F. Compressor: Hermetic scroll, (VA: Type) with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
- G. Refrigeration Circuit: Low-pressure switch, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
- H. Refrigerant: R-410A unless otherwise indicated.
- I. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.

1. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1-2007 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- J. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube copper-fin coil with propeller fan, direct driven.
- K. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.
- L. Hydronic Cooling Coil: Seamless copper tubes expanded into aluminum fins with two-way control valve.
 1. Cooling Medium: Water
 2. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1-2010 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- M. Electric-Resistance Heating Coil: Finned-tube electric elements with contactor, dehumidification relay, and high-temperature-limit switches.
- N. Filter: 25-mm (1 inch) thick, disposable, glass-fiber media.
 1. Recommended Final Resistance: 75 Pa (0.3 inches wg).
 2. Initial Resistance: 25 Pa (0.1 inches wg).
 3. Arrestance: 90 percent according to ASHRAE 52.1.
 4. MERV Rating: 7 according to ASHRAE 52.2.
- O. Electrode Steam Humidifier: Self-contained, microprocessor-controlled unit with disposable, polypropylene-plastic cylinders, and having field-adjustable steel electrodes and stainless-steel steam dispersion tube.
- P. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.
- Q. Control: Fully modulating to provide gradual 0 to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.
- R. Drain Cycle: Field-adjustable drain duration and drain interval.
- S. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- T. Control System: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control and humidity control modules, time-delay relay, heating contactor, and high-temperature thermostat. Wall-mounted control panel shall be solid-state, with start-stop switch, adjustable humidity, dirty set point and adjustable temperature set point.
- W. DDC Interface: Provide connection to DDC system.

2.3 FAN MOTORS

- A. Default motor characteristics are specified in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.
- B. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.
- C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0. Provide high static fan motors for ducted applications.
- D. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.6 SPECIAL TOOLS

If any part of equipment furnished under these specifications requires a special tool for assembly, adjustment, setting, or maintenance and the tool is not readily available from the commercial tool market, furnish the necessary tools with equipment as a standard accessory

2.7 CORROSION CONTROL

- A. Remote Outdoor Condenser Coils:
 - 1. Epoxy Immersion Coating - Electrically Deposited: The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall be such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:
 - a. Salt Spray Resistance (Minimum 6,000 Hours)
 - b. Humidity Resistance (Minimum 1,000 Hours)
 - c. Water Immersion (Minimum 260 Hours)
 - d. Cross-Hatch Adhesion (Minimum 4B-5B Rating)
 - e. Impact Resistance (Up to 160 Inch/Pound)
- B. Exposed Outdoor Cabinet

1. Casing Surfaces (Exterior and Interior): All exposed and accessible metal surfaces shall be protected with a water-reducible acrylic with stainless steel pigment spray-applied over the manufacturer's standard finish. The spray coating thickness shall be 2-4 mils and provide minimum salt-spray resistance of 1,000 hours (ASTM B117) AND 500 hours UV resistance (ASTM D4587).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Handle and install refrigeration units and accessories in accordance with the instructions and recommendations of the manufacturer.
- B. Coordinate installation of Computer room Air Conditioning Units with Computer room access flooring installer.
- C. Field Refrigerant Piping: As specified in specification Section 23 23 00, REFRIGERANT PIPING.
- D. Field Piping: Glycol Piping, Hot water Piping, Steam and Condensate Piping, as specified in specification Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM and CONDENSATE HEATING PIPING.
- E. Fill glycol system with 40 percent glycol mixture and perform start-up procedures as recommended by the manufacturer.
- F. Electrical System Connections and Equipment Ground: As specified in Division 26 Sections.

3.2 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to machine to allow service and maintenance.
- D. Water and Drainage Connections: Comply with applicable requirements in Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING and Section 22 11 00, FACILITY WATER DISTRIBUTION. Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.
- E. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00, REFRIGERANT PIPING. Provide shutoff valves and piping.

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.

2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. After startup service and performance test, change filters and flush humidifier.

3.4 INSTRUCTIONS

Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of computer room air conditioning equipment.

3.5 STARTUP AND TESTING

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

3.6 COMMISSIONING

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

3.7 DEMONSTRATION AND TRAINING

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

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SECTION-23 82 16
AIR COILS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Heating and cooling coils for air handling unit.

1.2 RELATED WORK

- A. Section 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC AND STEAM GENERATION EQUIPMENT
- B. Section 23 73 00, INDOOR CENTRAL STATION AIR HANDLING UNITS

1.3 QUALITY ASSURANCE

- A. Refer to paragraph, QUALITY ASSURANCE, Section, 23 05 12, GENERAL MOTOR REQ'TS FOR HVAC AND STEAM GENERATION EQUIPMENT
- B. Unless specifically exempted by these specifications, heating and cooling coils shall be tested, rated, and certified in accordance with ARI Standard 410 and shall bear the ARI certification label.

1.4 SUBMITTALS

In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, furnish the following:

- A. Manufacturer's Literature and Data for Heating and Cooling Coils: Submit type, size, arrangements and performance details. Present application ratings in the form of tables, charts or curves. Provide installation, operating and maintenance instructions.
- B. Certification Compliance: Evidence of listing in current ARI Directory of Certified Applied Air Conditioning Products.
- C. Coils may be submitted with Section 23 73 10, INDOOR CENTRAL AIR HANDLING UNITS.

1.5 APPLICABLE PUBLICATIONS

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

- A. Air Conditioning and Refrigeration Institute (ARI):
Directory of Certified Applied Air Conditioning Products.
ARI 410-81....Forced Circulation Air Cooling and Air Heating Coils.

PART 2 - PRODUCTS

2.1 HEATING AND COOLING COILS

- A. Tubes: Seamless copper tubing.
- B. Fins: 0.0045 inch copper mechanically bonded or soldered or helically wound around tubing.
- C. Headers: Copper, welded steel or cast iron.

- D. "U" Bends, Where Used: Machine die formed, silver brazed to tube ends.
- E. Coil Casing: 16 gage galvanized steel with tube supports at 48-inch maximum spacing. Construct casing to eliminate air bypass and moisture carry-over. Provide duct connection flanges.
- F. Pressures PSIG: Water Coil
Test: 300
Working: 200
- G. Protection: Unless protected by the coil casing, provide cardboard, plywood, or plastic material at the factory to protect tube and finned surfaces during shipping and construction activities.
- H. Vents and Drain: Coils that are not vented or drainable by the piping system shall have capped vent/drain connections extended through coil casing.
- I. Cooling Coil Condensate Drain Pan: Section, AIR HANDLING UNITS.

2.2 WATER COILS

- A. Drainable Type (Self-Draining, Self-Venting):
 - 1. Cooling, all types. Cooling coil velocity shall not exceed 2.6 m/s (500 fpm) for constant volume systems and 2.8 m/s (550 fpm) for variable air volume systems.
 - 2. Heating or preheat. Heating/Reheat Coils shall be mounted heating coils shall preferably be hot water type. The face velocity of these coils shall not exceed 2.8 m/s (550 fpm).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Follow coil manufacturer's instructions for handling and installation.
- B. Comb fins if damaged. Eliminate air bypass leakage at coil sections.

3.2 Demonstration and Training

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

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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 wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, switchboards, panelboards, and other items and arrangements for the specified items are shown on drawings.
- C. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. References to the International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) 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 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
 - 1. Listed; Equipment, materials, or services 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 equipment or materials or periodic evaluation of services, and whose

listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.

2. Labeled; Equipment or materials 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 equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified; equipment or product which:
 - a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
 - c. Bears a label, tag, or other record of certification.
4. Nationally recognized testing laboratory; laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.4 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.

1.5 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 or type of equipment is required, such units shall be the product of a single manufacturer.

1.6 EQUIPMENT REQUIREMENTS

- A. Where variations from the contract requirements are requested in accordance with Section 00 72 00, 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.

1.7 EQUIPMENT PROTECTION

- A. Equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
 - 1. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Equipment shall include but not be limited to switchboards, panelboards, transformers, enclosures, controllers, circuit protective devices, cables, wire, light fixtures, electronic equipment, and accessories.
 - 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, as determined by the Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
 - 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 - 5. 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.

1.8 WORK PERFORMANCE

- A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K 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. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Resident Engineer.
- D. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working spaces shall not be less than specified in the NEC for all voltages specified.
- C. 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 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.

1.10 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, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
- B. Nameplates for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Nameplates 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 1/2 inch [12mm] high. Nameplates 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.

1.11 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.
 - 2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
 - 3. 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 those replacement parts recommended by the equipment manufacturer.
- 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.

G. Approvals will be based on complete submission of manuals together with shop drawings.

1.12 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

1.13 PCB EQUIPMENT

- A. This project requires the removal, transport and disposal of electrical equipment containing Polychlorinated Biphenyl (PCB) in accordance with the Federal Toxic Substances Control Act (TSCA).
- B. The equipment for removal is shown on the drawings.
- C. The selective demolition shall be in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1.14 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 Project Engineer at least 30 days prior to the planned training.
- required to complete the installation as shown on the drawings.

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SECTION 26 05 21
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of the low voltage power and lighting wiring.

1.2 RELATED WORK

- A. General electrical requirements that are common to more than one section in Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- C. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
1. Manufacturer's Literature and Data: Showing each cable type and rating.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):
D2301-04.....Standard Specification for Vinyl Chloride
Plastic Pressure Sensitive Electrical Insulating
Tape
- C. Federal Specifications (Fed. Spec.):
A-A-59544-00.....Cable and Wire, Electrical (Power, Fixed
Installation)
- C. National Fire Protection Association (NFPA):
70-05.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
44-02.....Thermoset-Insulated Wires and Cables
83-03.....Thermoplastic-Insulated Wires and Cables
467-01.....Electrical Grounding and Bonding Equipment
486A-01.....Wire Connectors and Soldering Lugs for Use with
Copper Conductors

terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. 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.

4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.

2.2 SPLICES AND JOINTS

- A. In accordance with UL 486A, C, D, E and NEC.
- B. Branch circuits (No. 10 AWG and smaller):
 1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C with integral insulation, approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped wires.
 3. The number, size, and combination of conductors, as listed on the manufacturers packaging shall be strictly complied with.
- C. Feeder Circuits:
 1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material.
 2. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
 3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less than that of the conductor level that is being joined.

2.3 CONTROL WIRING

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum sizes shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 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.

2.5 FIREPROOFING TAPE

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with the NEC, and as specified.
- B. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- C. Wires of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.
- D. 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.
- E. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- F. Wire Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - 2. Use ropes made of nonmetallic material for pulling feeders.
 - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer.
 - 4. Pull in multiple cables together in a single conduit.

3.2 SPLICE INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure.
- B. 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.

3.3 CONTROL AND SIGNAL WIRING INSTALLATION

- A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.

- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

3.4 CONTROL AND SIGNAL SYSTEM IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.

3.5 FIELD TESTING

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Tests shall be performed by megger and conductors shall test free from short-circuits and grounds.
- C. Test conductor phase-to-phase and phase-to-ground.
- D. The Contractor shall furnish the instruments, materials, and labor for these tests.

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.
- B. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL 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.

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. National Fire Protection Association (NFPA):
 - 70-2005.....National Electrical Code (NEC)
 - 99-2005.....Health Care Facilities

C. 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.

PART 3 - EXECUTION

3.1 GENERAL

- A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.
- B. System Grounding: Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.
- D. Special Grounding: For patient care area electrical power system grounding, conform to NFPA 99, and NEC.

3.4 SECONDARY EQUIPMENT AND CIRCUITS

- A. Transformers: 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.
- B. 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.
- C. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- D. 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.
 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.
- D. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.
- E. 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.
- F. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
- H. Panelboard Bonding: The equipment grounding terminal buses of the normal and essential branch circuit panelboards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than 16 mm² (10 AWG). These conductors shall be installed in rigid metal conduit.

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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. Bedding of conduits: Section 31 20 00, EARTH MOVING.
- B. Mounting board for telephone closets: Section 06 10 00, ROUGH CARPENTRY.
- C. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- D. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.
- F. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- G. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- H. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL 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 main feeders;
 - 2. Size and location of panels and pull boxes
 - 3. Layout of required conduit penetrations through structural elements.
 - 4. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Certification: Prior to final inspection, deliver to the 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 COTR prior to drilling through structural sections.
 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the COTR as required by limited working space.
- B. Fire Stop: 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, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

- A. In accordance with UL, NEC, as shown, and as hereinafter specified.
- B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where specifically "accepted" by NEC Article 517.
- C. 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 and electrically 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.
- 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.

2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the 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 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.

3.5 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 explosive proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.6 WET OR DAMP LOCATIONS

- A. Unless otherwise shown, use conduits of rigid steel or IMC.
- B. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces building exterior walls, roofs) or similar spaces.
- C. Unless otherwise shown, use rigid steel or IMC conduit within 1500 mm (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall include an outer factory coating of .5 mm (20 mil) bonded PVC or field coat with asphaltum before

installation. After installation, completely coat damaged areas of coating.

3.7 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. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

3.8 EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.
- D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

3.9 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.

3.10 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 1. Flush mounted.
 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes.)
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.

- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with black marker.

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SECTION 26 05 71
ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the requirements of the Electrical System Protective Device Study. The contractor shall submit the study prior or along with electrical equipment shop drawings.
- B. A short circuit and coordination study shall be prepared for the electrical over current devices to be installed under this project to assure proper equipment and personnel protection.
- C. The study shall present an organized time-current analysis of each protective device in series from the new panel back to the upstream distribution board. The study shall reflect the operation of each device during normal and abnormal current conditions.

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 24 16, PANELBOARDS: Low voltage panelboards.
- E. Section 26 24 11, DISTRIBUTION PANELBOARDS: Low voltage distribution panelboards.

1.3 SUBMITTALS

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Complete short circuit and coordination study as described herein.
- C. Protective equipment shop drawings shall be submitted simultaneously with or after the protective device study. Protective equipment shop drawings will not be accepted prior to protective device study.
- D. Certification: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
 - 1. Certification by the Contractor that the protective devices have been adjusted and set in accordance with the approved protective device study.

1.4 QUALIFICATIONS

The protective device study shall be prepared by qualified engineers of the manufacturer or an approved consultant. The Contractor is responsible for providing all pertinent information required by the preparers to complete the study.

1.5 REQUIREMENTS

- A. The complete study shall include a system one line diagram, short circuit and ground fault analysis, and protective coordination plots.
- B. One Line Diagram:
 - 1. Show, on the one line diagram, all electrical equipment and wiring to be protected by the overcurrent devices installed under this project. Clearly show, on the one line, the schematic wiring of the electrical distribution system.
 - 2. Also show on the one line diagram the following specific information:
 - a. Calculated fault impedance, X/R ratios, and short circuit values at the new panel.
 - b. Breaker and fuse ratings.
 - c. Voltage at each bus.
 - d. Identification of each bus.
 - e. Conduit material, feeder sizes, length, and X/R ratios.
- C. Short Circuit Study:
 - 1. Systematically calculate the fault impedance to determine the available short circuit and ground fault currents at each bus. Incorporate the motor contribution in determining the momentary and interrupting ratings of the protective devices.
 - 2. The study shall be calculated by means of a computer program. Pertinent data and the rationale employed in developing the calculations shall be incorporated in the introductory remarks of the study.
 - 3. Present the data determined by the short circuit study in a table format. Include the following:
 - a. Device identification.
 - b. Operating voltage.
 - c. Protective device.
 - d. Device rating.
 - e. Calculated short circuit current.
- D. Coordination Curves:
 - 1. Prepare the coordination curves to determine the required settings of protective devices to assure selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between new panel and upstream board.
 - 2. The following specific information shall also be shown on the coordination curves:
 - a. Device identification.
 - b. Voltage and current ratio for curves.
 - c. 3-phase and 1-phase ANSI damage points for each transformer.

- d. No-damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum short circuit cutoff point.
3. Develop a table to summarize the settings selected for the protective devices. Include the following in the table:
- a. Device identification.
 - b. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
 - c. Fuse rating and type.

1.6 ANALYSIS

- A. Analyze the short circuit calculations, and highlight any equipment that is determined to be underrated as specified. Propose approaches to effectively protect the underrated equipment. Provide minor modifications to conform with the study (Examples of minor modifications are trip sizes within the same frame, the time curve characteristics of induction relays, C.T. ranges, etc.).
- B. After developing the coordination curves, highlight areas lacking coordination. Present a technical evaluation with a discussion of the logical compromises for best coordination.

1.7 ADJUSTMENTS, SETTINGS AND MODIFICATIONS

- A. Necessary final field adjustments, settings and minor modifications shall be made to conform with the protective device study without additional cost to the Government.
- B. All final circuit breaker and fuse sizes shall be made in accordance with the recommendations of the protective device study.

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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 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.
- B. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, event and alarm signals, tabulated reports, and event logs.
- C. PC: Personal computer; sometimes plural as "PCs."
- D. DALI: Digitally Addressable Lighting Interface. An international standard for bi-directional communication between smart addressable lighting equipment such as fluorescent ballasts, motion sensors, and wall switches. Relies on a polarity-insensitive two-wire bus running between all devices. Wire may be run in conduit with power or free in plenum with appropriately rated wire. Each DALI bus is powered by either a digital control cabinet or a standalone DALI power supply.
- E. ZigBee: An international standard for bi-directional wireless mesh network communication. Works at the 2.4GHz frequency and uses secure 128 bit encryption for all traffic.
- F. Mesh network: A robust and highly reliable method of communicating between wireless devices. Designed to withstand failures of individual nodes by routing around the issue. Used to communicate between digital control cabinets (where a wired connection between cabinets is not possible) .and remote devices controlling individual fixtures or stand-alone wired fixture groups.

- G. 0-10V: A standard interface for controlling dimmable lighting loads where the signal voltage from 0 to 10 volts is proportional to the light output of the lamp being controlled.

1.5 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. Product Data Sheets: Detailed data sheets must be provided for control cabinets and all related materials and devices required to provide full system functionality.
- E. Shop Drawings: Submittals shall include detailed drawings showing integration of all required components assembled to accomplish specific system design intent.
1. Outline Drawings: Indicate dimensions, arrangement of components, and clearance and access requirements.
 2. Block Diagram: Show interconnections between components specified in this section and devices furnished with interrelated system. Indicate data communication paths and identify networks, data buses, and other devices to be used. Describe characteristics of network and required data communication lines.
 3. Wiring Diagrams: Provide drawings which clearly indicate power, signal, and control wiring.
- F. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
1. Show interconnecting signal and control wiring and interfacing devices that support compatibility of inputs and outputs.
 2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

G. Software and Firmware Operational Documentation:

1. Manuals: Provide software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, supply initial commissioning tables complete with data files.
3. Device address list.

H. Field quality-control test reports.

I. Software licenses: Provide names and ownership certifications of all software required by and installed for operation and programming of digital and analog devices.

J. Operation Data: Provide "Sequence of Information" for established lighting scenes including all normal and emergency modes of operation.

K. Warranty: Specify warranty for all hardware and software elements covered in this Section.

L. 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.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: All Components must be listed and labeled by a recognized testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Factory Assembly: All relays, touch tablet graphic user interfaces, controllers, enclosures, switch stations, photo sensors, occupancy sensors and miscellaneous components shall be factory assembled and tested. All system components shall arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits and network terminations. All connections shall be made to clearly and permanently labeled termination points. Systems that require field assembly shall not be acceptable.

C. Component Testing: All system components and assemblies shall be individually tested prior to assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications prior to shipment.

D. NEC Compliance: All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.

E. NEMA Compliance: All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

- F. UL Approval: All applicable equipment shall be tested to and listed under UL standard 508 and/or UL 916 and shall bear labels to indicate compliance.
- G. FCC Emissions: All applicable equipment shall comply with FCC emissions standards specified in Part 15, subpart B for commercial and residential applications and shall bear labels indicating compliance testing.
- Equipment that does not meet these standards shall not be acceptable.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Green Seal (GS):
GC-12.....Occupancy Sensors
- C. Illuminating Engineering Society of North America (IESNA):
IESNA LM-48.....Guide for Calibration of Photoelectric Control Devices
- D. National Electrical Manufacturer's Association (NEMA)
C136.10.....American National Standard for Roadway Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing
- ICS-1.....Standard for Industrial Control and Systems General Requirements
- ICS-2.....Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
- ICS-6.....Standard for Industrial Controls and Systems Enclosures
- E. Underwriters Laboratories, Inc. (UL):
20.....Standard for General-Use Snap Switches
- 773.....Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting
- 773ANonindustrial Photoelectric Switches for Lighting Control
- 98.....Enclosed and Dead-Front Switches
- 917.....Clock Operated Switches

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following: Failure of software input/output to execute switching or dimming commands.

2 Warranty Period: One year from date of Substantial Completion.

1.9 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Provide remote software support for one year (requires system internet access) from date of Substantial Completion

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available with one year from date of Substantial Completion. Upgrade shall include new or revised licenses for use of the software.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Exergy Controls, LLC

2.2 SYSTEM REQUIREMENTS

A. Performance Requirements: Individually addressable devices are operated via digital signals transmitted and received through a two-wire DALI-based network and/or wireless mesh network. CNetwork control is achieved via wired Ethernet connection to the Internet (requiring no extra gateway or translator equipment) and/or ZigBee transceiver - both communication technologies integrated into each digital control cabinet. System shall support simultaneous wired and wireless bidirectional communication between digital control cabinet and each wired/wireless device.

B. Summary of required system features. System shall:

1. Be based on the international DALI standard, the ZigBee wireless mesh network standard at 2.4GHz frequency, and the ubiquitous Ethernet communication standard

2. Consist of one or more digital control cabinets that act as base stations for the DALI and wireless network

3. Provide a digital control cabinet to be mounted indoors with an Internet connection via a 10/100 Base-T Ethernet line that allows remote monitoring and control of the entire system without requiring a dedicate telephone line to the system.

4. Provide individually-addressable, bi-directional communication between each control device in the system. Controllers and ballasts shall respond appropriately to status queries.
5. Support grouping of ballasts into as many as 16 different groups per DALI bus.
6. Support up to 16 different preset scenes per DALI ballast.
7. Utilize industry-standard 256-bit AES encryption for Ethernet communication and 128-bit AES encryption for wireless communication
8. Come standard with PC-based control software allowing users to control and monitor the system at no additional cost. System operational history (energy used) shall be logged and be retrievable via software so performance can be measured.
9. Provide a robust scheduling system based on an astronomical time clock allowing individual fixture control
10. Come with a no-additional-cost 1-year support contract. Extended yearly support available at competitive rates

2.3 CONTROL MODULE

- A. The system is controlled via a network of digital control cabinets. The control cabinet(s) provides the base station for the wireless network as well a wired Ethernet connection for communication with any Internet-enabled device.

2.4 MATERIALS

- A. Electrical contractor shall provide and install a complete Digital System (Control Cabinets, Switches, Sensors and all ancillary devices) of the types and quantities shown on the drawings and specified herein to complete a comprehensive and fully functioning system to meet the design intent.
- B. Digital control cabinet: Base station for simultaneous wired and wireless digital communication between fixtures, devices, other system Digital Control Cabinets and the Internet
 1. Hybrid system connectivity
 - a. Multiple DALI networks can be linked together using wireless ZigBee or Ethernet communication
 - b. Seamless communication between DALI networks
 - c. Mesh networked wireless digital communications
 - d. Allows integration of multiple control cabinets into one unified system
 - e. Control cabinet can be used as an independent element or multiple control cabinets can be combined into a robust network with Ethernet or wireless connectivity between nodes.

- f. Supported external communication protocols including Internet standards such as XML, SOAP, http, plus RS-232 and others.
- 2. Wired communication
 - a. Each control cabinet supports up to 4 DALI digital control busses, with up to 64 fixtures (50 fixtures recommended to allow for future expansion) on each bus.
 - b. Up to 2 programmable-function dry-contact inputs per cabinet
 - c. 128-bit hardware-assisted AES encryption for all wireless traffic
 - d. Makes full use of a Local Area Network (LAN) connection to provide wired connectivity between control cabinets
 - e. Autosensing 10/100 Base-T LAN and Internet connectivity directly into cabinet
- 3. Comprehensive web server interface for configuration of network parameters
- 4. Automatic network discovery of peer cabinets on LAN
- 5. Wireless communication
 - a. ZigBee IEEE 802.15.4-based open standard
 - b. Supports up to 150 wireless devices per wireless network. A virtually unlimited number of wireless networks can be combined into a unified system using Ethernet connections.
 - c. Spread spectrum frequency agile wireless communication
 - d. Secure bi-directional wireless mesh network
- 6. Maintenance, monitoring, and remote access
 - a. Allows remote troubleshooting by authorized manufacturer personnel to review system operation and aid in commissioning activities
 - b. Real-Time System Status: True two-way communication between cabinet, ballasts and all devices allows current status of all components and knowledge of any device failures.
- 7. Certifications
 - a. All control components meet or exceed Title 24 efficiency standards and are listed with the California Energy Commission, where appropriate
- 8. Construction:
 - a. Each lighting control panel shall be manufactured of continuously welded steel
 - 1) 16 GA for housing and covers
 - 2) 18 GA for all internal (non-structural) covers/elements.
 - b. Finish: Control Cabinets shall be primed and painted with a powder coat finish. Unpainted or galvanized enclosures are not acceptable.

- c. Computer circuitry fully enclosed in tamper- resistant compartment with 16 GA steel cover
 - d. Power Supply: Listed Dual 120/277 VAC, 60Hz, 40VA MAX Class II transformer
 - e. Connections: All connections shall be made to clearly and permanently labeled termination points.
- 9. Computer Hardware: Digital circuit design will incorporate a motherboard capable of:
 - a. Providing back-up storage of ballast and device settings for all elements supported by its control circuits
 - b. Coordinating communication between all internal and external digital circuits comprising the complete system
 - c. Incorporating removable circuit cards providing
 - 1) 1 to 4 digital communication busses, providing expansion as needed
 - 2) Wireless communication via 2.4GHz ZigBee protocol
 - 3) Additional slot for future expansion or technological improvements
- C. Lighting Control Software: Powerful post-installation data logging and system support
 - 1. Individual user control via simple-to-use Windows taskbar icon
 - 2. Comprehensive system control and monitoring for building managers
 - 3. Ability to change settings and light levels on the fly
 - 4. Track ballast and lamp life down to the minute to take advantage of warranties
 - 5. Track history of power usage with detail down to a single fixture
 - 6. Integrated Demand Response over the internet
 - 7. Flexibility to set schedules base on what a user wants
 - 8. Create maintenance reports automatically and email someone daily/weekly/monthly...
- D. Occupancy sensor
 - 1. Sensing options available in the system: passive infrared (PIR), ultrasonic (US), PIR + US dual-technology, acoustic, acoustic + PIR dual-technology.
 - 2. 450, 1000, and 2000 square foot coverage options, with 180° or 360° patterns
 - 3. Powered by direct connection to DALI bus
 - 4. No power pack required
 - 5. 4.5" Diameter, 1.5" high for ceiling mount sensors; standard decora-style form factor for wall sensors.
 - 6. Ceiling or wall mountable

7. Supports sensitivity and time delay adjustment
- E. Photo sensor
1. Robust light level input options from 1FC to 10000 FC
 2. Direct connection to the DALI bus. No additional wiring required.
 3. Can control up to 64 fixtures per photocell
 4. Interchangeable lens covers to support any environmental conditions
 5. Low-profile design, approx. 1" diameter, 2" tall with lens
- F. 5-button Wall switch
1. The 5-button switch is made up of two primary parts:
 - a. Cover plate and backbox containing the control circuitry
 - b. Two wires for connection to a DALI bus
 2. Simple to label and relabel with protective plastic cover
 3. Screwless cover
 4. Designed for installation into a single-gang box
 5. Dimensions: 2.75" x 4.5" x .94" (69.8mm x 114.3mm x 23.9mm)
 6. Can call up to 16 different lighting scenes
 7. Button function can be locked-out based on time schedule
- G. 5-button Wall switch with dim up and dim down adjustment
1. Fits conventional decorator switch openings
 2. Simple two-wire connection to a DALI loop.
 3. No extra wiring required
 4. Dimensions: 2.65" x 1.75" x 1.98" (67.1mm x 44.5 mm x 50.3mm) = L x W x D. Depth in wall = 1.65" (41.9mm).
 5. Designed for installation into a single-gang box with any Decora-style faceplate.
 6. Comes with dim up/dim down functionality and ability to call up to 16 scenes
 7. Elegant look and reliable operation for areas that demand fine-grained adjustment
- H. Wireless controls
1. All wireless controllers come standard with the following features:
 - a. Communicates via a secure bidirectional wireless link to all other wireless devices at the site, allowing individual control of each fixture, providing seamless 24/7 access to the fixture with the reliability of a wired system
 - b. 128-bit hardware-assisted AES encryption for all wireless traffic
 - c. ZigBee IEEE 802.15.4-based open standard at 2.4 GHz
 - d. Spread-spectrum frequency agile wireless communication for interference-free operation

- e. Supports up to 150 wireless devices per wireless network. A virtually unlimited number of wireless networks can be combined into a unified system using Ethernet connections.
 - f. For pole-mounted devices, a trouble-free mounting system designed to slide within standard 3" to 6" (inner diameter) poles is provided. The controller is housed within a damp-location rated extruded aluminum housing. Integral wires make system installation a snap.
 - g. Low profile antenna options mean the system is almost invisible to the naked eye
2. Available wireless control options include the following:
- a. Wirelessly-controlled 0-10V with line voltage switching
 - 1) Designed to be easily mounted in the pole of a parking lot light fixture, providing easy access to existing circuits for retrofit situations.
 - 2) Able to line-voltage switch up to four circuits independent of one another, allowing precise control over each head of a multi-head pole
 - 3) Provides two industry standard 0-10VDC outputs to dim any type of fluorescent, HID, LED, and HPS source accepting a 0-10V input. A flexible wiring scheme allows each of the two 0-10V outputs to control one or more fixtures as needed. Simple bi-level or continuous dimming is available from the same wireless device.
 - 4) Provides robust, zero-crossover line voltage switching using all solid-state components for improved switching life. No bulky contactors with life-limited moving parts are used.
 - b. Wirelessly-controlled PWM dimming for LEDs
 - 1) Designed to provide constant-voltage, continuous dimming from 100 percent of light output down to 4 percent of light output with more than 25 levels in between.
 - 2) Can be mounted in the pole of a parking lot light fixture, or provided as an integral part of certain fixtures.
 - 3) Wired between any standard constant-voltage LED driver and the fixture's LED array
 - 4) Provides a pulse frequency of at least 5kHz for clean, flicker-free light output
 - 5) Can control up to four constant-voltage circuits rated up to 4 amps each.
 - c. Wirelessly-controlled Standalone DALI power supply board

- 1) Provides power to a single DALI digital communications bus with a robust wireless communication front-end.
- 2) Allows the installation of a DALI control bus in remote locations where home-runs back to an Exergy Digital Control Cabinet would be impractical.
- 3) Supports a complete array of DALI functionality including up to 64 fixtures, 250mA of device load, and bidirectional communication with the larger lighting control network.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Comply with NECA 1.

3.2 MANUFACTURER'S SERVICES

- A. Installation Assistance: During the installation process, the manufacturer shall provide, at no cost, technical support via telephone to the installing contractor or Owner's representative to answer questions and supply additional information when required.
- B. System Start-Up: The system manufacturer shall provide a factory authorized field engineer to the project site after installation has been completed and prior to system energization for the purpose of testing and adjustment of the system. Factory field engineer shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 2 weeks prior to scheduling a field engineer for start-up of the system. Should the field engineer arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field engineer required to complete the system start-up.
- C. On-Site Programming: During the start-up procedure, the factory field engineer shall provide programming assistance and guidance to the building operating personnel in order to program the systems for initial operation.
- D. Instruction: During the start-up procedure, the factory field engineer shall provide training to the building operating personnel in the operation, programming and maintenance of the lighting control system.

3.3 SOFTWARE INSTALLATION

- A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values.

3.4 REMOTE ASSISTANCE

- A. Remote Support: The system manufacturer shall provide remote programming assistance (via Internet Access provided by others) for changes to system settings or reconfiguration of spaces for a period of one year from date of substantial completion. This support is intended to assist the owner with minor changes to the facilities operation and does not cover a complete redesign or recommissioning of system operation and/or function.

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SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of panelboards. The standard established at this facility is: Primary - Square D; Secondary - Cutler Hammer. Any deviation from these manufacturers will require request and justification in writing to the project manager for approval.

1.2 RELATED WORK

- A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of nonstructural components.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one Section of Division 26.
- C. Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY: Requirements for the over current protective devices to be installed to ensure proper equipment and personnel protection.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.
- E. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- F. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, materials, wiring diagrams accessories and weights of equipment. Complete nameplate data including manufacturer's name and catalog number.

C. Certification: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:

1. Certification that the material is in accordance with the drawings and specifications has been properly installed, and that the loads are balanced.

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. National Electrical Manufacturers Association (NEMA):

PB-1-2006.....Panelboards

AB-1-2002.....Molded Case Circuit Breakers, Molded Case
Switches and Circuit Breaker Enclosures

B. National Fire Protection Association (NFPA):

70-2005National Electrical Code (NEC)

70E-2004.....Standard for Electrical Life Safety in the
Workplace

C. Underwriters Laboratories, Inc. (UL):

50-2003.....Enclosures for Electrical Equipment

67-2003.....Panel boards

489-2006.....Molded Case Circuit Breakers and Circuit
Breaker Enclosures

PART 2 - PRODUCTS

2.1 PANELBOARDS

A. Panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.

B. Panelboards shall be standard manufactured products. All components of the panelboards shall be the product and assembly of the same manufacturer. All similar units of all panelboards are to be of the same manufacturer.

C. All panelboards shall be hinged "door in door" type with:

1. Interior hinged door with hand operated latch or latches as required to provide access to circuit breaker operating handles only, not to energized ports.
2. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips or other fasteners requiring a tool for entry, hand operated latches are not acceptable.

3. Push inner and outer doors shall open left to right.
- D. All panelboards shall be completely factory assembled with molded case circuit breakers. Include one-piece removable, inner dead front cover independent of the panelboard cover.
- E. Panelboards shall conform to NEMA PB-1, NEMA AB-1 and UL 67 and have the following features:
 1. Nonreduced size copper or aluminum bus bars, complete with current ratings as shown on the panel schedules connection straps bolted together and rigidly supported on molded insulators.
 2. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Single-phase, three-wire panelboard busing shall be such that when any two adjacent single-pole breakers are connected to opposite phases, two-pole breakers can be installed in any location. Three-phase, four-wire busing shall be such that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two-or three-pole breakers can be installed at any location. Current-carrying parts of the bus assembly shall be plated. Mains ratings shall be as shown.
 3. Mechanical lugs furnished with panelboards shall be cast, stamped or machined metal alloys of sizes suitable for the conductors indicated to be connected thereto.
 4. Neutral bus shall be 100% rated, mounted on insulated supports.
 5. Grounding bus bar equipped with screws or lugs for the connection of grounding wires.
 6. Buses braced for the available short circuit current, but not less than 22,000 amperes symmetrical for 120/208 volt and 120/240 volt panelboards, and 14,000 amperes symmetrical for 277/480-volt panelboards.
 7. Branch circuit panels shall have buses fabricated for bolt-on type circuit breakers.
 8. Where designated on panel schedule "spaces", include all necessary bussing, device support and connections. Provide blank cover for each space.

2.2 CABINETS AND TRIMS

- A. Cabinets:

1. Provide galvanized steel cabinets to house panelboards. Cabinets for outdoor panels shall be factory primed and suitably treated with a corrosion-resisting paint finish meeting UL 50 and UL 67.
2. Cabinet enclosure shall not have ventilating openings.
3. Cabinets for panelboards may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.

2.3 MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS

- A. Breakers shall be UL 489 listed and labeled, in accordance with the NEC, as shown on the drawings, and as specified.
- B. Circuit breakers in panelboards shall be bolt on type on phase bus bar or branch circuit bar.
 1. Molded case circuit breakers for lighting and appliance branch circuit panelboards shall have minimum interrupting rating as indicated but not less than:
 - a. 120/208 Volt Panelboard: 22,000 amperes symmetrical.
 - b. 120/240 Volt Panelboard: 22,000 amperes symmetrical.
 - c. 277/480 Volt Panelboard: 14,000 amperes symmetrical.
 2. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100-ampere frame or less.
- C. Breaker features shall be as follows:
 1. A rugged, integral housing of molded insulating material.
 2. Silver alloy contacts.
 3. Arc quenchers and phase barriers for each pole.
 4. Quick-make, quick-break, operating mechanisms.
 5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
 6. Electrically and mechanically trip free.
 7. An operating handle which indicates ON, TRIPPED, and OFF positions. Line connections shall be bolted.
 8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
 9. Shunt trips shall be provided where indicated
 10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory.

2.4 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

- A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.
- B. Enclosures are to be of the NEMA types shown on the drawings. Where the types are not shown, they are to be the NEMA type most suitable for the environmental conditions where the breakers are being installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the Manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected. Coordinate the sizes of cabinets with designated closet space.
- C. In accordance with Section 09 91 00, PAINTING, paint the panelboard system voltage, and feeder sizes as shown on the riser diagram in 1 inch block lettering on the inside cover of the cabinet door. Paint the words "LIFE SAFETY BRANCH", "CRITICAL BRANCH", or "EQUIPMENT SYSTEM" as applicable and the panel designation in one inch block letters on the outside of the cabinet doors.
- D. Install a typewritten schedule of circuits in each panelboard after being submitted to and approved by the Resident Engineer. Schedules, after approval, shall be typed on the panel directory cards and installed in the appropriate panelboards, incorporating all applicable contract changes pertaining to that schedule. Include the room numbers and items served on the cards.
- E. Mount the panelboard fully aligned and such that the maximum height of the top circuit breaker above finished floor shall not exceed 1980 mm (78 inches). For panelboards that are too high, mount panelboard so that the bottom of the cabinets will not be less than 150 mm (6 inches) above the finished floor.
- F. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims, doors, and boxes with finishes to match surrounding surfaces after the panelboards have been installed.
- G. Directory-card information shall be typewritten to indicate outlets, lights, devices, and equipment controlled and final room numbers served by each circuit and shall be mounted in holders behind protective covering.

H. Where new panels are to be installed in existing backboxes, backboxes shall have rust and scale removed from inside. Paint inside of backboxes with rust preventive paint before the new panel interior is installed. Provide new trim and doors for these panels. Covers shall fit tight to the box with no gaps between the cover and the box.

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SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection 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: Conduits and outlets boxes.
- 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.

1.3 SUBMITTALS

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, construction materials, grade and termination information.
- C. Manuals: Two weeks prior to final inspection, deliver four copies of the following to the Resident Engineer: Technical data sheets and information for ordering replacement units.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer: Certification by the Contractor that the devices comply with the drawings and specifications, and have been properly installed, aligned, 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 basic designation only.
- B. National Fire Protection Association (NFPA):
70.....National Electrical Code (NEC)

- C. National Electrical Manufacturers Association (NEMA):
 - WD 1.....General Color Requirements for Wiring Devices
 - WD 6Wiring Devices - Dimensional Requirements
- D. Underwriter's Laboratories, Inc. (UL):
 - 5.....Surface Metal Raceways and Fittings
 - 20.....General-Use Snap Switches
 - 231.....Power Outlets
 - 467.....Grounding and Bonding Equipment
 - 498.....Attachment Plugs and Receptacles
 - 943.....Ground-Fault Circuit-Interrupters

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General: All receptacles shall be listed by Underwriters Laboratories, Inc.
 - 1. All receptacles in patient care areas shall be hospital grade type (green dot)
 - 2. 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.
 - 3. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four min.) and side wiring from four captively held binding screws.
- B. Duplex Receptacles: Hospital-grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, and conform to the NEMA 5-20R configuration in NEMA WD 6. The duplex type shall have break-off feature for two-circuit operation. The ungrounded pole of each receptacle shall be provided with a separate terminal.
 - 1. Bodies shall be ivory in color.
 - 2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The remaining 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.
 - 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 five milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or - 1 milliamp) on the load

side of the device. Device shall have a minimum nominal tripping time of 1/30th of a 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 phenolic compound supported by a plated steel mounting strap having plaster ears.
- C. Receptacles; 20, 30 and 50 ampere, 250 volts: Shall be complete with appropriate cord grip plug. Devices shall meet UL 231.
- 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 bodies of phenolic compound. Toggle handles shall be ivory in color unless otherwise specified. The rocker type switch is not acceptable and will not be approved.
 - 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 plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
- 3. Ratings:
 - a. 120 volt circuits: 20 amperes at 120-277 volts AC.
 - b. 277 volt circuits: 20 amperes at 120-277 volts AC.

2.3 MANUAL DIMMING CONTROL

- A. Slide dimmer with on/off control, single-pole or three-way as shown on plans. Faceplates shall be ivory in color unless otherwise specified.
- B. Manual dimming controls shall be fully compatible with electronic dimming ballasts and approved by the ballast manufacturer, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.

2.4 WALL PLATES

- A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.
- B. Standard NEMA design, so that products of different manufacturers will be interchangeable. Dimensions for openings in wall plates shall be accordance with NEMA WD 6.
- C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- D. Duplex Receptacles on Emergency Circuit:
 - 1. Bodies shall be red in color. Wall plates shall be letter engraved on plate denoting circuit number and panel feeding.

2.5 SURFACE MULTIPLE-OUTLET ASSEMBLIES

- A. Assemblies shall conform to the requirements of NFPA 70 and UL 5.
- B. Shall have the following features:
 - 1. Enclosures:
 - a. Thickness of steel shall be not less than 0.040 inch [1mm] steel for base and cover. Nominal dimension shall be 1-1/2 by 2-3/4 inches [40 by 70mm] with inside cross sectional area not less than 3.5 square inches [2250 square mm]. The enclosures shall be thoroughly cleaned, phosphatized and painted at the factory with primer and the manufacturer's standard baked enamel or lacquer 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, spacing of the receptacles along the strip shall be 24 inches [600mm] on centers.
 - 4. Wires within the assemblies shall be not less than No. 12 AWG copper, with 600 volt ratings.
 - 5. Installation fittings shall be designed for the strips being installed including bends, offsets, device brackets, inside couplings, wire clips, and elbows.

6. Bond the strips to the conduit systems for their branch supply circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the green equipment grounding conductor.
- C. Outlet boxes for light and dimmer switches shall be mounted on the strike side of doors.
- D. Provide barriers in multigang outlet boxes to separate systems of different voltages, Normal Power and Emergency Power systems, and in compliance with the NEC.
- E. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work. 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.
- F. 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. In addition, check for exact direction of door swings so that local switches are properly located on the strike side.
- G. Install wall switches 48 inches [1200mm] above floor, OFF position down.
- H. Install wall dimmers 48 inches [1200mm] above floor; derate ganged dimmers as instructed by manufacturer; do not use common neutral.
- I. Install convenience receptacles 18 inches [450mm] above floor, and 6 inches [152mm] above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- J. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.
- K. 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.

L. Test GFCI devices for tripping values specified in UL 1436 and UL 943.

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SECTION 26 29 11
MOTOR STARTERS

PART 1 - GENERAL

1.1 DESCRIPTION

All motor starters and variable speed motor controllers, including installation and connection (whether furnished with the equipment specified in other Divisions or otherwise), shall meet these specifications.

1.2 RELATED WORK

- A. Other sections which specify motor driven equipment, except elevator motor controllers.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for Seismic Restraint for Nonstructural Components.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one Section of Division 26.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:

- A. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, weights, mounting details, materials, running over current protection, size of enclosure, over current protection, wiring diagrams, starting characteristics, interlocking and accessories.
- B. Manuals:
 - 1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams and information for ordering replacement parts.
 - a. Wiring diagrams shall have their terminals identified to facilitate installation, maintenance and operation.

- b. Wiring diagrams shall indicate internal wiring for each item of equipment and interconnections between the items of equipment.
- c. Elementary schematic diagrams shall be provided for clarity of operation.
- 2. Two weeks prior to the project final inspection, submit four copies of the final updated maintenance and operating manual to the Resident Engineer.
- C. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certifications to the COTR:
 - 1. Certification 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 basic designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE):
 - 519.....Recommended Practices and Requirements for
Harmonic Control in Electrical Power Systems
 - C37.90.1.....Standard Surge Withstand Capability (SWC) Tests
for Protective Relays and Relay Systems
- C. National Electrical Manufacturers Association (NEMA):
 - ICS 1.....Industrial Control and Systems General
Requirements
 - ICS 1.1.....Safety Guidelines for the Application,
Installation and Maintenance of Solid State
Control
 - ICS 2.....Industrial Control and Systems, Controllers,
Contactors and Overload Relays Rated 600 Volts
DC
 - ICS 6.....Industrial Control and Systems Enclosures
 - ICS 7.....Industrial Control and Systems Adjustable-Speed
Drives
 - ICS 7.1.....Safety Standards for Construction and Guide for
Selection, Installation and Operation of
Adjustable-Speed Drive Systems
- D. National Fire Protection Association (NFPA):
 - 70.....National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 MOTOR STARTERS, GENERAL

- A. Shall be in accordance with the requirements of the IEEE, NEC, NEMA (ICS 1, ICS 1.1, ICS 2, ICS 6) and UL.
- B. Shall have the following features:
 - 1. Separately enclosed unless part of another assembly.
 - 2. Circuit breakers and safety switches within the motor controller enclosures shall have external operating handles with lock-open padlocking provisions and shall indicate the ON and OFF positions.
 - 3. Motor control circuits:
 - a. Shall operate at not more than 120 volts.
 - b. Shall be grounded except as follows:
 - 1) Where isolated control circuits are shown.
 - 2) Where manufacturers of equipment assemblies recommend that the control circuits be isolated.
 - c. Incorporate a separate, heavy duty, control transformer within each motor controller enclosure to provide the control voltage for each motor operating over 120 volts.
 - d. Incorporate over current protection for both primary and secondary windings of the control power transformers in accordance with the NEC.
 - 4. Overload current protective devices:
 - a. Thermal or induction type.
 - b. Overload relay solid state type.
 - c. One for each pole.
 - d. Manual reset on the door of each motor controller enclosure.
 - e. Correctly sized for the associated motor's rated full load current.
 - f. Check every motor controller after installation and verify that correct sizes of protective devices have been installed.
 - g. Deliver four copies of a summarized list to the Resident Engineer, which indicates and adequately identifies every motor controller installed. Include the catalog numbers for the correct sizes of protective devices for the motor controllers.
 - 5. Hand-Off-Automatic (H-O-A) switch is required unless specifically stated on the drawings as not required for a particular starter. H-O-A switch is not required for manual motor starters.
 - 6. Incorporate into each control circuit a 120-volt, solid state time delay relay (ON delay), minimum adjustable range from 0.3 to 10 minutes, with transient protection. Time delay relay is not required where H-O-A switch is not required.

7. Unless noted otherwise, equip with not less than two normally open and two normally closed auxiliary contacts. Provide green run pilot lights and H-O-A control devices as indicated, operable at front of enclosure without opening enclosure. Push buttons, selector switches, pilot lights, etc., shall be interchangeable.
8. Enclosures:
 - a. Shall be the NEMA types shown on the drawings for the motor controllers and shall be the NEMA types which are the most suitable for the environmental conditions where the motor controllers are being installed.
 - b. Doors mechanically interlocked to prevent opening unless the breaker or switch within the enclosure is open. Provision for padlock must be provided.
 - c. Enclosures shall be primed and finish coated at the factory with the manufacturer's prime coat and standard finish.
- C. Motor controllers incorporated with equipment assemblies shall also be designed for the specific requirements of the assemblies.
- D. For motor controllers being installed in existing motor control centers or panelboards, coordinate with the existing centers or panelboards.
- E. Additional requirements for specific motor controllers, as indicated in other sections, shall also apply.
- F. Provide a disconnecting means or safety switch near and within sight of each motor. Provide all wiring and conduit required to facilitate a complete installation.

2.2 MANUAL MOTOR STARTERS

- A. Shall be in accordance with applicable requirements of 2.1 above.
- B. Manual motor starters.
 1. Starters shall be general-purpose Class A, manually operated type with full voltage controller for induction motors, rated in horsepower.
 2. Units shall include overload protection, red pilot light and toggle operator.
- C. Fractional horsepower manual motor starters.
 1. Starters shall be general-purpose Class A, manually operated with full voltage controller for fractional horsepower induction motors.
 2. Units shall include thermal overload protection, red pilot light and toggle operator.
- D. Motor starting switches.
 1. Switches shall be general-purpose Class A, manually operated type with full voltage controller for fractional horsepower induction motors.

2. Units shall include thermal overload protection, red pilot light and toggle operator.

2.3 MAGNETIC MOTOR STARTERS

- A. Shall be in accordance with applicable requirements of 2.1 above.
- B. Starters shall be general-purpose, Class A magnetic controllers for induction motors rated in horsepower. Minimum size 0.
- C. Where combination motor starters are used, combine starter with protective or disconnect device in a common enclosure.
- D. Provide phase loss protection for each starter, with contacts to de-energize the starter upon loss of any phase.
- E. Unless otherwise indicated, provide full voltage non-reversing across-the-line mechanisms for motors less than 75 HP, closed by coil action and opened by gravity. For motors 75 HP and larger, provide reduced voltage starters. Equip starters with 120V AC coils and individual control transformer unless otherwise noted. Locate "reset" button to be accessible without opening the enclosure.

2.4 MOTOR CONTROL STATIONS

- A. Shall have the following features:
 1. Designed for suitably fulfilling the specific control functions for which each station is being installed.
 2. Coordinate the use of momentary contacts and maintained contacts with the complete motor control systems to insure safety for people and equipment.
 3. Each station shall have two pilot lights behind red and green jewels and a circuit to its motor controller. Connect the lamps so they will be energized as follows:
 - a. Red while the motor is running.
 - b. Green while the motor is stopped.
 4. Where two or more stations are mounted adjacent to each other, install a common wall plate, except where the designs of the stations make such common plates impracticable.
 5. Identify each station with a permanently attached individual nameplate, of laminated black phenolic resin with a white core and engraved lettering not less than 6 mm (1/4-inch) high. Identify the motor by its number or other designation and indicate the function fulfilled by the motor.

B. Components of Motor Control Circuits:

1. Shall also be designed and arranged so that accidental faulting or grounding of the control conductors will not be able to start the motors.
2. Use of locking type STOP pushbuttons or switches, which cause motors to restart automatically when the pushbuttons or switches are released, will not be permitted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motor control equipment in accordance with manufacturer's recommendations, the NEC, NEMA and as shown on the drawings.
- B. In seismic areas, equipment shall be adequately anchored and braced per details on structural contract drawing to withstand the seismic forces at the location where installed.
- C. Furnish and install heater elements in motor starters and to match the installed motor characteristics. Submit a list of all motors listing motor nameplate rating and heater element installed.
- D. Motor Data: Provide neatly-typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, voltage/phase rating and heater element installed.
- E. Connect hand-off auto selector switches so that automatic control only is by-passed in "manual" position and any safety controls are not by-passed.
- F. Install manual motor starters in flush enclosures in finished areas.
- G. Examine control diagrams indicated before ordering motor controllers. Should conflicting data exist in specifications, drawings and diagrams, request corrected data prior to placing orders.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections and electrical tests:
 1. Visual and Mechanical Inspection
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Inspect contactors.
 - d. Verify overload element ratings are correct for their applications.
 - e. If motor-running protection is provided by fuses, verify correct fuse rating.

- f. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the motor starters and variable speed motor controllers are in good operating condition and properly performing the intended functions.

3.4 SPARE PARTS

Two weeks prior to the final inspection, provide one complete set of spare fuses (including heater elements) for each starter/controller installed on this project.

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SECTION 26 29 21
DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of low voltage disconnect switches.

1.2 RELATED WORK

- A. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- C. Cables and wiring: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW.
- D. Motor rated toggle switches: Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
- E. Requirements for personnel safety and to provide a low impedance path for possible ground faults: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Include sufficient information, clearly presented to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting details, materials, enclosure types, fuse type and class.
 - 3. Show the specific switch and fuse proposed for each specific piece of equipment or circuit.
- C. Manuals:
 - 1. Provide complete maintenance and operating manuals for disconnect switches, including technical data sheets, wiring diagrams, and information for ordering replacement parts. Deliver four copies to the COTR two weeks prior to final inspection.
 - 2. Identify terminals on wiring diagrams to facilitate maintenance and operation.
 - 3. Wiring diagrams shall indicate internal wiring and any interlocking.
- D. Certification: Two weeks prior to final inspection, deliver to the // Resident Engineer // COTR // four copies of the certification that the equipment has been properly installed, adjusted, 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 the basic designation only.
- B. National Electrical Manufacturers Association (NEMA):
KS 1-01.....Enclosed and Miscellaneous Distribution
Equipment Switches (600 Volts Maximum)
- C. National Fire Protection Association (NFPA):
70-05.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
98-98.....Enclosed and Dead-Front Switches
198C-89.....High-Interrupting-Capacity Fuses, Current
Limiting Types
198E-94.....Class R Fuses
977-99.....Fused Power-Circuit Devices

PART 2 - PRODUCTS

2.1 LOW VOLTAGE FUSIBLE SWITCHES RATED 600 AMPERES AND LESS

- A. Shall be quick-make, quick-break type in accordance with UL 98, NEMA KS 1 and NEC.
- B. Shall have a minimum duty rating, NEMA classification General Duty (GD) for 240 volts and NEMA classification Heavy Duty (HD) for 277/480 volts.
- C. Shall be horsepower rated.
- D. Shall have the following features:
 - 1. Switch mechanism shall be the quick-make, quick-break type.
 - 2. Copper blades, visible in the OFF position.
 - 3. An arc chute for each pole.
 - 4. External operating handle shall indicate ON and OFF position and shall have lock-open padlocking provisions.
 - 5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable by a special tool to permit inspection.
 - 6. Fuse holders for the sizes and types of fuses specified.
 - 7. Ground Lugs: One for each ground conductor.
 - 8. Enclosures:
 - a. Shall be the NEMA types shown on the drawings for the switches.
 - b. Where the types of switch enclosures are not shown, they shall be the NEMA types which are most suitable for the environmental conditions where the switches are being installed. Unless otherwise indicated on the plans, all outdoor switches shall be NEMA 3R.

- c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel (for the type of enclosure required).

2.2 LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS

Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, but no fuses.

2.3 MOTOR RATED TOGGLE SWITCHES

Refer to Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for motor rated toggle switches.

2.4 IDENTIFICATION SIGNS

- A. Install nameplate identification signs on each disconnect switch to identify the equipment controlled.
- 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches in accordance with the NEC and as shown on the drawings.
- B. Fusible disconnect switches shall be furnished complete with fuses.

3.2 SPARE PARTS

Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fusible disconnect switch installed on the project. Deliver the spare fuses to the COTR.

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SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies the furnishing, installation and connection of the interior lighting systems.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- D. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

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 fixture (luminaire) designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of fixture designation, submit the following information.
 - 1. Material and construction details include information on housing, optics system and lens/diffuser.
 - 2. Physical dimensions and description.
 - 3. Wiring schematic and connection diagram.
 - 4. Installation details.
 - 5. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts and total harmonic distortion (THD).
- 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. Institute of Electrical and Electronic Engineers (IEEE):
C62.41-91.....Guide on the Surge Environment in Low Voltage
(1000V and less) AC Power Circuits
- C. National Fire Protection Association (NFPA):
70.....National Electrical Code (NEC)
101.....Life Safety Code
- D. National Electrical Manufacturer's Association (NEMA):
C82.1-97.....Ballasts for Fluorescent Lamps - Specifications
C82.2-02.....Method of Measurement of Fluorescent Lamp
Ballasts
C82.4-02.....Ballasts for High-Intensity-Discharge and Low-
Pressure Sodium Lamps
C82.11-02.....High Frequency Fluorescent Lamp Ballasts
- E. Underwriters Laboratories, Inc. (UL):
496-96.....Edison-Base Lampholders
542-99.....Lampholders, Starters, and Starter Holders for
Fluorescent Lamps
844-95.....Electric Lighting Fixtures for Use in Hazardous
(Classified) Locations

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES (LUMINAIRES)

- A. Shall be in accordance with NFPA 70 and UL 1598, 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; lens doors shall close in a light tight manner.
 4. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, latches shall function easily by finger action without the use of tools.
- C. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- D. All lighting ballast with a 120 b to 277v 50/60 Hz controllable programmed start electronic type ballast. Premium grade digital dimming ballast that is microchip controlled. Provide for a network communication platform that will allow simultaneous wiring communication between lighting fixtures, sensors, user controls and the internet. The lighting network shall be a part of the building DDC controls network with power and control wire to the lighting system pulled together.
- E. Lamp Sockets:
1. Fluorescent: Lampholder contacts shall be the biting edge type or phosphorous-bronze with silver flash contact surface type and shall conform to the applicable requirements of UL 542. Lamp holders for bi-pin lamps shall be of the telescoping compression type, or of the single slot entry type requiring a one-quarter turn of the lamp after insertion.
- F. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- G. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- H. 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.
 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.

- I. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
- J. Light Transmitting Components for Fluorescent Fixtures:
 - 1. Shall be 100 percent virgin acrylic.
 - 2. Unless otherwise specified, lenses, 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 of the lens without distortion or cracking.

2.2 BALLASTS

- A. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 - 277V) electronic type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated.
- B. Low-Frequency Linear T8 Fluorescent Lamp Ballasts (allowed for Surgery Suites, Critical Care Units and Animal Labs): //120V// //277V// hybrid electronic-electromagnetic rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output; including the following features:
 - 1. Automatic lamp starting after lamp replacement.
 - 2. Sound Rating: Class A.
 - 3. Total Harmonic Distortion Rating: 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 47 CFT 18, Ch.1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
- C. Compact Fluorescent Lamp Ballasts: Multi-voltage (120 - 277V), electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated; including 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 Rating: 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 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

2.3 LAMPS

- A. Linear and U-shaped T5 and T8 Fluorescent Lamps:
 1. Rapid start fluorescent lamps shall comply with ANSI C78.1; and instant-start lamps shall comply with ANSI C78.3.
 2. Chromacity of fluorescent lamps shall comply with ANSI C78.376.
 3. Except as indicated below, lamps shall be low-mercury energy saving type, have a cool white color, a Color Rendering Index (CRI) of greater than 70, average rated life of 20,000 hours, and be suitable for use with dimming ballasts, unless otherwise indicated. Low mercury lamps shall have passed the EPA Toxicity Characteristic Leachate Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.
 - 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.
 - b. Other areas as indicated on the drawings.

2.4 EXIT LIGHT FIXTURES

- A. Exit light fixtures shall meet applicable requirements of NFPA 101 and UL 924.
- B. Housing and Canopy:
 1. Shall be made of die-cast aluminum.
 2. Optional steel housing shall be a minimum 20 gauge thick or equivalent strength aluminum.
 3. Steel housing shall have baked enamel over corrosion resistant, matte black or ivory white primer.
- C. Door frame shall be cast or extruded aluminum, and hinged with latch.
- 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 0.090 inch [2.25mm] thick, stenciled with 6 inch [150mm] 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. The LED shall be rated minimum 25 years life.
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. Voltages: Refer to Lighting Fixture Schedule.

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. Fluorescent bed light fixtures shall be attached to the studs in the walls. Attachment to gypsum board only is not acceptable.
- 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 20 pounds [9kg] in weight.
 - 1) Where fixtures mounted in ASTM Standard C635-69 "Intermediate" and "Heavy Duty" ceilings and weigh between 20 pounds and 56 pounds [9kg and 25kg] provide two 12 gauge safety hangers hung slack between diagonal corners of the fixture and the building structure.
 - 2) Where fixtures weigh over 56 pounds [25kg] 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.
5. Surface mounted lighting fixtures:
- a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 1/4-20 [6mm] 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 56 pounds [25kg] 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 15 pounds [6.8kg] in weight and occupying less than two square feet [600mm x 600mm] 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.
- 6. Single or double pendant-mounted lighting fixtures:
 - a. Each stem shall be supported by an approved outlet box, mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.
- 7. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.
- E. Furnish and install the specified lamps for all lighting fixtures installed and all existing lighting fixtures reinstalled under this project.
- F. Coordinate between the electrical and ceiling trades to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.
- G. Bond lighting fixtures and metal accessories to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- H. Exercise electronic dimming ballasts over full range of dimming capability by operating the control devices(s) in the presence of the COTR. Observe for visually detectable flicker over full dimming range.
- I. 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 a lesser period is specifically recommended by lamp manufacturer. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage. Replace any lamps and ballasts which fail during burn-in.
- J. At completion of project, relamp/reballast fixtures which have failed lamps/ballasts. Clean fixtures, lenses, diffusers and louvers that have accumulated dust/dirt/fingerprints during construction. Replace damaged lenses, diffusers and louvers with new.

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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 four 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 Section 00 72 00, 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 Section 00 72 00, 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.
 - 2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
 - 3. 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.

I. In addition to the requirement of SUBMITTALS, the VA reserves the right to request the manufacturer to arrange for a VA representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.

1.11 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.

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SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies general grounding and bonding requirements of telecommunication installations for equipment operations.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, telecommunications system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

- A. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 27.
- B. Section 27 10 00, STRUCTURED CABLING: Low Voltage power and lighting wiring.
- C. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for a lightning protection system.
- D. Section 01 00 00, GENERAL REQUIREMENTS

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.

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.

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SECTION 27 05 33
RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, raceway systems. Raceways are required for all communications cabling unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

- A. Mounting board for communication closets: Section 06 10 00, ROUGH CARPENTRY.
- B. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- C. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.
- D. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- E. General electrical requirements and items that is common to more than one section of Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- F. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- G. Section 01 00 00, GENERAL REQUIREMENTS

1.3 SUBMITTALS

In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

- A. Shop Drawings:
 - Include required information for items in the applicable shop drawings for other sections as required.
 - 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 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. 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. 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. FIRESTOPPING shall comply with standard UL listed Through Penetration Firestop Systems per the UL Fire Resistance Directory.

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.

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 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 and interstitial spaces.
- 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.

3.5 EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.
- D. Seismic Requirement: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

3.6 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.

- b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
- c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.7 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. 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).

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**SECTION 27 10 00
STRUCTURED CABLING**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of the structured cabling system to provide a comprehensive Data and telecommunications infrastructure.

1.2 RELATED WORK

- A. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- B. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- E. Section 01 00 00, GENERAL REQUIREMENTS

1.3 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
 - 1. Manufacturer's Literature and Data: Showing each cable type and rating.
 - 2. Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):
 - D2301-04.....Standard Specification for Vinyl Chloride
Plastic Pressure Sensitive Electrical Insulating
Tape
- C. Federal Specifications (Fed. Spec.):
 - A-A-59544-00.....Cable and Wire, Electrical (Power, Fixed
Installation)

D. National Fire Protection Association (NFPA):

70-05.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-02.....Thermoset-Insulated Wires and Cables

83-03.....Thermoplastic-Insulated Wires and Cables

467-01.....Electrical Grounding and Bonding Equipment

486A-01.....Wire Connectors and Soldering Lugs for Use with
Copper Conductors

486C-02.....Splicing Wire Connectors

486D-02.....Insulated Wire Connector Systems for Underground
Use or in Damp or Wet Locations

486E-00.....Equipment Wiring Terminals for Use with Aluminum
and/or Copper Conductors

493-01.....Thermoplastic-Insulated Underground Feeder and
Branch Circuit Cable

514B-02.....Fittings for Cable and Conduit

1479-03.....Fire Tests of Through-Penetration Fire Stops

1.5 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. Provide final As Built drawings to COTR in AutoCAD 2007 Format.

B. The floor plans shall be marked in pen to include the following:

1. All device locations with labels.
2. Conduit locations.
3. Head-end equipment and specific location.
4. Wiring diagram.
5. Labeling and administration documentation.
6. Warranty certificate.
7. System test results.

PART 2 - PRODUCTS

2.1 CONTROL WIRING

A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.

B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.2 COMMUNICATION AND SIGNAL WIRING

A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.

B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.

C. Multi-conductor cables shall have the conductors color coded.

2.3 WIRE LUBRICATING COMPOUND

A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

B. Shall not be used on wire for isolated type electrical power systems.

2.4 FIREPROOFING TAPE

A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.

C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.

D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.

E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install all wiring in conduit stub-ups into the interstitial space. Install in cable tray or raceway where available.

B. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.

C. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
2. Use ropes made of nonmetallic material for pulling feeders.
3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer.
4. Pull in multiple cables together in a single conduit.

3.2 CONTROL, COMMUNICATION AND SIGNAL WIRING INSTALLATION

A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.

- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

3.3 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.

3.5 EXISITNG WIRING

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.

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SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies the furnishing, installing, certification, testing, and guaranty of a complete and operating Data, Voice and Digital Cable Distribution System (here-in-after referred to as "*the System*"), and associated equipment and hardware to be installed in the VA Medical Center, here-in-after referred to as "*the Facility*". The System shall include, but not be limited to: equipment cabinets, interface enclosures, and relay racks; necessary combiners, traps, and filters; and necessary passive devices such as: splitters, couplers, cable "patch", "punch down", and cross-connector blocks or devices, voice and data distribution sub-systems, and associated hardware. The System shall additionally include, but not be limited to: telecommunication closets (TC); telecommunications outlets (TCO); copper and fiber optic, and analog radio frequency (RF) systems coaxial distribution cables, connectors, "patch" cables, and/or "break out" devices.
- B. The System shall be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.
- C. The term "provide", as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.
- D. The Data, Voice and Digital Telecommunication Distribution Cable Equipment and System provides the media which voice and data information travels over and connects to the Data & Telephone System which is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Therefore, since the System connects to or extends the telephone system, the System's installation and operation shall adhere to all appropriate National, Government, and/or Local Life Safety and/or Support Codes, which ever are the more stringent for this Facility. At a minimum , the System shall be installed according to NFPA, Section 70, National Electrical Code (NEC), Article 517 and Chapter 7; NFPA, Section 99, Health Care Facilities, Chapter 3-4; NFPA, Section 101, Life Safety Code, Chapters 7, 12, and/or 13; Joint Commission on Accreditation of Health Care

Organization (JCAHCO), Manual for Health Care Facilities, all necessary Life Safety and/or Support guidelines; this specification; and the original equipment manufacturer's (OEM) suggested installation design, recommendations, and instructions. The OEM and Contractor shall ensure that all management, sales, engineering, and installation personnel have read and understand the requirements of this specification before the System is designed, engineered, delivered, and provided.

- E. The VA Project Manager (PM) and/or if delegated, Resident Engineer (RE) or COTR are the approving authorities for all contractual and mechanical changes to the System. The Contractor is cautioned to obtain in writing, all approvals for system changes relating to the published contract specifications and drawings, from the COTR and/or the RE before proceeding with the change.

F. System Performance:

1. At a minimum, the System shall be able to support the following voice and data and analog RF operations for Category 6 Certified Telecommunication Service:
 - a. Provide the following interchange (or interface) capabilities:
 - 1) Basic Rate (BRI).
 - 2) Primary Rate (PRI).
 - b. ISDN measured at:
 - 1) Narrow Band BRI:
 - a) B Channel: 64 kilo-Bits per second (kBps), minimum.
 - b) D Channel: 16 kBps, minimum.
 - c) H Channel: 384 kBps, minimum.
 - 2) Narrow Band PRI:
 - a) B Channel: 64 kBps, minimum.
 - b) D Channel: 64 kBps, minimum.
 - c) H Channel: 1,920 kBps, minimum.
 - 3) Wide (or Broad) Band: All channels: 140 mega(m)-Bps, minimum, capable to 565 mBps at "T" reference.
 - c. ATM operation and interface: ATM 155 mBps measured
 - d. Frame Relay: All stated compliance's measured
 - e. Integrated Data Communications Utility (IDCU) operation and interface: Measured
 - f. Government Open Systems Interconnection Profile (GOSSIP) compliant: Measured

- g. Fiberoptic Distributed Data Interface (FDDI): A minimum 100 mBps to a maximum of 1.8 giga(g)-Bps data bit stream speed measured (shall be Synchronous Optical Network [SONET] compliant).
 - h. System Sensitivity: Satisfactory service shall be provided for at least 3,000 feet for all voice and data and analog RF locations.
2. At a minimum the System shall support the following operating parameters:
- a. EPBX connection:
 - 1) System speed: 1.0 gBps per second, minimum.
 - 2) Impedance: 600 Ohms.
 - 3) Cross Modulation: -60 deci-Bel (dB).
 - 4) Hum Modulation: -55 dB.
 - 5) System data error: 10 to the -10 Bps, minimum.
 - 6) Loss: Measured at the frame output with reference Zero (0) deciBel measured (dBm) at 1,000 Hertz (Hz) applied to the frame input.
 - a) Trunk to station: 1.5 dB, maximum.
 - b) Station to station: 3.0 dB, maximum.
 - c) Internal switch crosstalk: -60 dB when a signal of ± 10 deciBel measured (dBm), 500-2,500 Hz range is applied to the primary path.
 - d) Idle channel noise: 25 dBm "C" or 3.0 dBm "O" above reference (terminated) ground noise, whichever is greater.
 - e) Traffic Grade of Service for Voice and Data:
 - (1) A minimum grade of service of P-01 with an average traffic load of 7.0 CCS per station per hour and a traffic overload in the data circuits will not interfere with, or degrade, the voice service.
 - (2) Average CCS per voice station: The average CCS capacity per voice station shall be maintained at 7.0 CCS when the EPBX is expanded up to the projected maximum growth as stated herein.
 - b. Telecommunications Outlet (TCO):
 - 1) Voice:
 - a) Isolation (outlet-outlet): 24 dB.
 - b) Impedance: 600 Ohms, balanced (BAL).
 - c) Signal Level: 0 deciBel per mili-Volt (dBmV) ± 0.1 dBmV.
 - d) System speed: 100 mBps, minimum.

- e) System data error: 10 to the -6 Bps, minimum.
- 2) Data:
 - a) Isolation (outlet-outlet): 24 dB.
 - b) Impedance: 600 Ohms, BAL.
 - c) Signal Level: 0 dBmV \pm 0.1 dBmV.
 - d) System speed: 120 mBps, minimum.
 - e) System data error: 10 to the -8 Bps, minimum.
- c. Other Outlets and services:
 - 1) Fiber optic:
 - a) Isolation (outlet-outlet): 36 dB.
 - b) Signal Level: 0 dBmV \pm 0.1 dBmV.
 - c) System speed: 540 mBps, minimum.
 - d) System data error: 10 to the -6 bps, minimum.
 - 2) Analog RF Service:
 - a) Broadcast or "off air" RF (or television) analog service is considered to be at RF (below 900 mHz in frequency bandwidth). Usually a RF television circuits require a single coaxial cable plant from the headend to each TC location.
 - b) Isolation (outlet-outlet): 14 dB.
 - c) Impedance: 75 Ohms, Unbalanced (UNBAL).
 - d) Signal Level: 10 dBmV \pm 5.0 dBmV.
 - e) Bandwidth: 6.0 mHz per channel, fully loaded.
 - 3) Closed Circuit Analog Video Service: Analog video service is considered to be at baseband (below 100 mHz in frequency bandwidth). An analog video circuit requires a separate analog video from the audio connector. The following minimum operating parameters shall be capable over each installed analog video circuit:

Impedance	75 Ohm, unbalanced
Output Level	1.0 V peak to peak (P-P), for 87.5% depth of Modulation (Mod)
Diff Gain	\pm 1 dB at 87.5% Mod
Diff Phase	\pm 1.5 at 87.5% Mod
Signal to Noise (S/N) ratio	44 dB, minimum
Hum Modulation	-55 dB
Return Loss	-14 dB (or 1.5 Voltage Standing Wave Ratio [VSWR]), maximum

Isolation (outlet-outlet)	24 DB, MINIMUM
Bandwidth	6.0 mHz per channel, fully loaded, minimum

- 4) Closed Circuit Analog Audio Service: Analog audio service is considered to be at baseband (below 10 mHz in frequency bandwidth). Usually an analog audio circuit requires separate audio connectors and video connectors even though both are considered baseband signals. However, since each TCO has multiple 600 (or 120) Ohm BAL line pairs, the analog audio circuit may be designated to one of the provided pairs of UTP or STP for each TCO and as shown on the drawings, in lieu of providing a separate baseband audio run to the TCO. The following minimum operating parameters shall be capable over each installed analog audio circuit:

Impedance	600 Ohm, BAL
Input Level	59 mV Root Mean Squared (RMS), minimum
Output Level	0 dBm
S/N ratio	55 dB, minimum
Hum Modulation	-50 dB, minimum
Return Loss	-14 dB (or 1.5 VSWR), maximum
Isolation (outlet-outlet)	24 DB, MINIMUM
Frequency Bandwidth	100 Hz - 10K Hz, minimum //

1.2 RELATED WORK

- A. Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Specification Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Specification Section 27 10 00, STRUCTURED CABLING.
- E. Specification Section 26 27 26, WIRING DEVICES.
- F. Specification Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

- G. Specification Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- H. Specification Section 27 32 41, TWO-WAY RADIO EQUIPMENT.
- I. Specification Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT.
- J. Specification Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION.
- L. Specification Section 27 51 16, PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS.
- M. Specification Section 27 41 31, MASTER ANTENNA TV EQUIPMENT AND SYSTEMS.
- N. Section 01 00 00, GENERAL REQUIREMENTS
- O. H-088-C3 VA HANDBOOK DESIGN FOR TELEPHONE SYSTEMS

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. Except for a specific date given the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date the system's submittal is technically approved by VA, shall be enforced.

- B. National Fire Protection Association (NFPA):

70	NATIONAL ELECTRICAL CODE (NEC)
75	Protection of Electronic Computer/Data Processing Equipment
77	Recommended Practice on Static Electricity
99	Standard for Health Care Facilities
101	Life Safety Code
1221	Emergency Services Communication Systems

- C. Underwriters Laboratories, Inc. (UL):

65	Wired Cabinets
96	Lightning Protection Components
96A	INSTALLATION REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEMS
467	Grounding and Bonding Equipment
497/497A/497B	PROTECTORS FOR PAIRED CONDUCTORS/ COMMUNICATIONS CIRCUITS/DATA COMMUNICATIONS AND FIRE ALARM CIRCUITS
884	Underfloor Raceways and Fittings

D. ANSI/EIA/TIA Publications:

568B	Commercial Building Telecommunications Wiring Standard
569B	Commercial Building Standard for Telecommunications Pathways and Spaces
606A	ADMINISTRATION STANDARD FOR THE TELECOMMUNICATIONS INFRASTRUCTURE OF COMMERCIAL BUILDINGS
607A	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings
758	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings

E. Lucent Technologies: Document 900-200-318 "Outside Plant Engineering Handbook".

F. International Telecommunication Union - Telecommunication Standardization Sector (ITU-T).

G. Federal Information Processing Standards (FIPS) Publications.

H. Federal Communications Commission (FCC) Publications: Standards for telephone equipment and systems.

I. United States Air Force: Technical Order 33K-1-100 Test Measurement and Diagnostic Equipment (TMDE) Interval Reference Guide.

J. Joint Commission on Accreditation of Health Care Organization (JCAHO): Comprehensive Accreditation Manual for Hospitals.

K. National and/or Government Life Safety Code(s): The more stringent of each listed code.

1.4 QUALITY ASSURANCE

A. The authorized representative of the OEM, shall be responsible for the design, satisfactory total operation of the System, and its certification.

B. The OEM shall meet the minimum requirements identified in Paragraph 2.1.A. Additionally the Contractor shall have had experience with three or more installations of systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identification of these installations shall be provided as a part of the submittal as identified in Paragraph 1.5.

C. The System Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the

OEM for a minimum of three (3) years. The System Contractor shall be authorized by the OEM to certify and warranty the installed equipment. In addition, the OEM and System Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System. This documentation, along with the System Contractor and OEM certification must be provided in writing as part of the Contractor's Technical Submittal.

- D. All equipment, cabling, terminating hardware, TCOs, and patch cords shall be sourced from the certifying OEM or at the OEM's direction, and support the System design, the OEM's quality control and validity of the OEM's warranty.
- E. The Contractor's Telecommunications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the RE before being allowed to commence work on the System.

1.5 SUBMITTALS

- A. Provide submittals in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The COTR shall retain one copy for review and approval.
 - 1. If the submittal is approved the RE shall retain one copy for Official Records and return three (3) copies to the Contractor.
 - 2. If the submittal is disapproved, three (3) copies will be returned to the Contractor with a written explanation attached that indicates the areas the submittal deviated from the System specifications. The RE shall retain one copy for Official Records.
- B. Environmental Requirements: Technical submittals shall confirm the environmental specifications for physical TC areas occupied by the System. These environmental specifications shall identify the requirements for initial and expanded system configurations for:
 - 1. Floor loading for batteries/ups and cabinets.
 - 2. Minimum floor space and ceiling heights.
 - 3. Minimum size of doors for equipment passage.
 - 4. Power requirements: The Contractor shall provide the specific voltage, amperage, phases, and quantities of circuits required.

5. Air conditioning, heating, and humidity requirements. The Contractor shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
 6. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).
 7. Proposed floor plan, based on the expanded system configuration of the bidder's proposed EPBX for this FACILITY.
 8. Conduit size requirement (between main TC, computer, and console rooms).
 9. Main backbone, trunk line, riser, and horizontal cable pathways, cable duct, and conduit requirements between each MTC, TC, and TCO.
- C. Documents: The submittal shall be separated into sections for each subsystem and shall contain the following:
1. Title page to include:
 - a. VA Medical Center.
 - b. Contractor's name, address, and telephone (including FAX) numbers.
 - c. Date of Submittal.
 - d. VA Project No.
 2. List containing a minimum of three locations of installations of similar size and complexity as identified herein. These locations shall contain the following:
 - a. Installation Location and Name.
 - b. Owner's or User's name, address, and telephone (including FAX) numbers.
 - c. Date of Project Start and Date of Final Acceptance by Owner.
 - d. System Project Number.
 - e. Brief (three paragraphs minimum) description of each system's function, operation, and installation.
 3. Narrative Description of the system.
 4. A List of the equipment to be furnished.

QUANTITY	UNIT
//As required//	Cabinet Assembly(s)
//As required//	Environmental Cabinet
//As required//	Distribution/Interface Cabinet
//As required//	Equipment (Radio Relay) Rack

//As required//	Cross Connection (CCS) Systems
//As required//	UPS Battery Backup (Rack)
//As required//	TROUBLE ANNUNCIATOR PANEL
//As required//	Lightning Protection System
//As required//	Wire Management System/Equipment
//As required//	Telecommunications Outlets (TCO)
//As Required//	Distribution Cables
//As required//	TCO Connection Cables
//As required//	System Connectors
//As required//	Terminators
//As required//	Distribution Frames
//As required//	Telecommunications Closets (TC)
//As required//	Environmental Requirements
1 ea.	Installation Kit
//As-required//	Separate List Containing Each Equipment Spare(s)

5. Pictorial layouts of each MTC, IMTC, and RTCs; MCCS, IMCCS, VCCS, and HCCS termination cabinet(s), each distribution cabinet layout drawing, and TCO as each is expected to be installed and configured.
 6. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
 7. Engineering drawings of the System, showing calculated signal levels at the EPBX output, each input and output distribution point, proposed TCO values, and signal level at each TCO multipin, fiberoptic, and coaxial cable jack.
 8. List of test equipment as per paragraph 1.5.D. below.
 9. Letter certifying that the Contractor understands the requirements of the SAMPLES Paragraph 1.5.E.
 10. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning acceptance tests.
- D. Test Equipment List:
1. The Contractor is responsible for furnishing all test equipment required to test the system in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the system. The Contractor shall furnish test equipment of accuracy better than the parameters to be tested.

2. The test equipment furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
 - a. Spectrum Analyzer.
 - b. Signal Level Meter.
 - c. Volt-Ohm Meter.
 - d. Time Domain Reflectometer (TDR) with strip chart recorder (Data and Optical Measuring).
 - e. Bit Error Test Set (BERT).
 - f. Camera with a minimum of 60 pictures to that will develop immediately to include appropriate test equipment adapters. A video camera in VHS format is an acceptable alternate.
 - g. Video Waveform Monitor.
 - h. Video Vector Scope.
 - i. Color Video Monitor with audio capability.
 - j. 100 mHz Oscilloscope with video adapters/
- E. Samples: A sample of each of the following items shall be furnished to the RE for approval prior to installation.
 1. TCO Wall Outlet Box 4" x 4"x 2.5" with:
 - a. One each telephone (or voice) rj45 jack installed.
 - b. Two each multi pin data rj45 jacks installed.
 - c. One blank
 - d. Cover Plate installed.
 2. Data CCS patch panel, punch block or connection device with RJ45 connectors installed.
 3. Telephone CCS system with IDC and/or RJ45 connectors and cable terminal equipment installed.
 4. Fiber optic CCS patch panel or breakout box with cable management equipment and "ST" connectors installed.
 5. 610 mm (2 ft.) section of each copper cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.
 6. 610 mm (2 ft.) section of each fiber optic cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.

7. 610 mm (2 ft.) section of each analog RF, video coaxial and audio cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.
8. Analog video CCS patch panel or breakout box with cable management equipment and "BNC" connectors installed.
9. Analog audio CCS patch panel or breakout box with cable management equipment and "XL" connectors installed.
10. Analog RF patch panel or breakout box with cable management equipment and "F" connectors installed.

F. Certifications:

1. Submit written certification from the OEM indicating that the proposed supervisor of the installation and the proposed provider of the contract maintenance are authorized representatives of the OEM. Include the individual's exact name and address and OEM credentials in the certification.
2. Submit written certification from the OEM that the wiring and connection diagrams meet National and/or Government Life Safety Guidelines, NFPA, NEC, UL, this specification, and JCAHCO requirements and instructions, requirements, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. The VA will not approve any submittal without this certification.
3. Preacceptance Certification: This certification shall be made in accordance with the test procedure outlined in paragraph 3.2.B.

G. Equipment Manuals: Fifteen (15) working days prior to the scheduled acceptance test, the Contractor shall deliver four complete sets of commercial operation and maintenance manuals for each item of equipment furnished as part of the System to the RE. The manuals shall detail the theory of operation and shall include narrative descriptions, pictorial illustrations, block and schematic diagrams, and parts list.

H. Record Wiring Diagrams:

1. Fifteen (15) working days prior to the acceptance test, the Contractor shall deliver four complete sets of the Record Wiring Diagrams of the System to the COTR. The diagrams shall show all inputs and outputs of electronic and passive equipment correctly identified according to the markers installed on the interconnecting cables, Equipment and room/area locations.

2. The Record Wiring Diagrams shall be in hard copy and two compact disk (CD) copies properly formatted to match the Facility's current operating version of Computer Aided Drafting (AutoCAD) system. The RE shall verify and inform the Contractor of the version of AutoCAD being used by the Facility.
- I. Surveys Required As A Part of the Technical Submittal: The Contractor shall provide the following surveys that depict various system features and capacities are 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:
1. The required EPBX connections (each CSU shall be compatible with) shall be compatible with the following:
 - a. Initially connect:

<u>EQUIPPED ITEM</u>	<u>CAPACITY</u>	<u>WIREDCAPACITY</u>
Main Station Lines		
Single Line		
Multi Line (Equipped for direct input dial [DID])		
Central Office (CO) Trunks		
TWO WAY		
DID		
Two-way DRTL		
Foreign Exchange (FX)		
Conference		
Radio Paging Access		
Audio Paging Access		
Off-Premise Extensions		
CO Trunk By-pass		
CRT w/keyboard		
Printers		
Attendant Consoles		
T-1 Access/Equipment		
Maintenance console		

- b. Projected Maximum Growth: The Contractor shall clearly and fully indicate this category for each item identified in Paragraph 1.4.H.1.a. as a part of the technical submittal. For this purpose, the following definitions and sample connections are provided to detail the system's capability:

EQUIPPED ITEM	CAPACITY	WIRED CAPACITY
Servers		
PC's		
Projected Maximum Growth		

The Contractor shall clearly and fully indicate this category for each item identified in Paragraph 1.4.H.2.a. as a part of the technical submittal.

2. Cable Distribution System Design Plan: A design plan for the entire cable distribution systems requirements shall be provided with this document. A specific cable count shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems entire cable requirements and engineer a distribution system requirement plan using the format of the following paragraph(s), at a minimum:

- a. UTP (and/or STP) Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
BUILDING	Identifies the building by number, title, or location cabling is to be provided in
TO BUILDING IMC	Identifies building main terminal signal closet, by room number or location, to which cabling is provided too, in, and from
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.) cabling and TCOs are to be provided
TC ROOM NUMBER	Identifies the floor signal closet room, by room number, which cabling shall be provided
ROOM NUMBER	Identifies the room, by number, from which

	cabling and TCOs shall be provided
NUMBER OF CABLE PAIR	Identifies the number of cable pair required to be provided on each floor designated OR the number of cable pair (VA Owned) to be retained
NUMBER OF STRANDS USED/SPARE	Identifies the number of strands provided in each run

b. Fiber Optic Cabling Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
TO BUILDING IMC	Identifies building, by number, title, or location, to which cabling is provided
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
NUMBER OF STRANDS	Identifies the number of strands in each run of fiber optic cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

c. Analog RF Cabling Requirements/Column Explanation:

Column	Explanation
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
TO FLOOR TC	Identifies building, by number or location, to which cabling is installed
NUMBER OF STRANDS	Identifies the number of strands in each run of RF cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment

BUILDING MTC	Identifies the building by number or title //
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d. Analog Video Cabling Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies building, by number or location, from which cabling is installed
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
TO BUILDING IMC	Identifies building, by number or location, to which cabling is installed
TC ROOM NUMBER	Identifies the room, by number, to which cabling shall be installed
NUMBER OF STRANDS	Identifies the number of strands in each run of fiber optic cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

3. Telecommunication Outlets: The Contractor shall clearly and fully indicate this category for each outlet location and compare the total count to the locations identified above as a part of the technical submittal. Additionally, the Contractor shall indicate the total number of spares.

1.6 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. Provide final As Built drawings to COTR in AutoCAD 2007 Format.
- B. The floor plans shall be marked in pen to include the following:
1. All device locations with labels.
 2. Conduit locations.
 3. Head-end equipment and specific location.
 4. Wiring diagram.
 5. Labeling and administration documentation.
 6. Warranty certificate.
 7. System test results.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. System Requirements:

1. The System shall provide the following minimum services that are designed in accordance with and supported by an Original Equipment Manufacturer (OEM), and as specified herein. The System shall provide continuous inter and/or intra-Facility voice and data, and analog RF service. The System shall be capacity sized so that loss of connectivity to external telephone systems shall not affect the Facilities operation in specific designated locations. The System shall:
 - a. Be capable of inter-connecting and functioning fully with the existing Local Telephone Exchange (LEC) Network(s), Federal Telephone System (FTS) Inter-city Network(s), Inter-exchange Carriers, Integrated Services Digital Network (ISDN), Electronic Private Branch Exchange (EPBX) switches, asynchronous/synchronous data terminals and circuits including Automatic Transfer Mode (ATM), Frame Relay, and local area networks (LAN), at a minimum.
 - b. Be a voice and data cable distribution system that is based on a physical "Star" and/or "Ring", and/or "Bus" Topology. An Analog RF coaxial cable distribution system shall be provided in a "home run" configuration from each associated riser TC to identified locations and as shown on the drawings.
 - c. Be compatible with and able to provide direct digital connection to trunk level equipment including, but, not limited to: directly accessing trunk level equipment including the telephone system, audio paging, Industry Standard "T" and/or "DS" carrier services and external protocol converters. Additionally, connections to "T" and/or "DS" access/equipment or Customer Service Units (CSU) that are used in FTS and other trunk applications shall be included in the System design. Provide T-1 access/equipment (or CSU), as required for use, in FTS and other trunk applications by system design if this equipment is not provided by the existing telephone system and/or will be deactivated by the installation of the System. The Contractor shall provide all T-1 equipment necessary to terminate and make operational the quantity of circuits designated. The CSU's shall be connected to the System's emergency battery power supply. The System shall be fully capable

of operating in the Industry Standard "DS" protocol and provide that service when required.

- d. Where the System connects to an existing or future telephone system, refer to specification Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT and specification Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION for specific telephone equipment and system operational performance standards.
2. Cable Systems - Twisted Pair and Fiber optic, and Analog RF Coaxial:
- a. General:
 - 1) The Contractor shall be responsible for providing a new system conforming to current and accepted telephone and digital, and analog RF industrial/commercial cable distribution standards. The distribution cable installation shall be fully coordinated with the Facility, the PM, the RE and the Contractor prior to the start of installation.
 - 2) The Contractor is responsible for complete knowledge of the space and cable pathways (i.e. equipment rooms, TCs, conduits, wireways, etc.) of the Facility. The Contractor shall at a minimum design and install the System using the Pathway Design Handbook H-088C3, TIA/EIA Telecommunications Building Wiring Standards, and Facility Chief of Information Resource Management's (IRM) instructions, as approved in writing by the PM and/or RE.
 - 3) The System cables shall be fully protected by cable duct, trays, wireways, conduit (rigid, thin wall, or flex), and flexible innerduct. It is the responsibility of the Contractor to confirm all contract drawings and the Facility's physical layout to determine the necessary cable protective devices to be provided. If flexible innerduct is used, it shall be installed in the same manner as conduit.
 - 4) Cable provided in the system (i.e. backbone, outside plant, inside plant, and station cabling) shall conform to accepted industry and OEM standards with regards to size, color code, and insulation. The pair twists of any pair shall not be exactly the same as any other pair within any unit or sub-unit of cables that are bundled in twenty-five (25) pairs or less. The absence of specifications regarding details shall imply

that best general industry practices shall prevail and that first quality material and workmanship shall be provided. Certification Standards, (i.e., EIA, CCITT, FIPPS, and NFPA) shall prevail.

- 5) Some areas of this Facility may be considered "plenum". All wire and cable used in support of the installation in those areas (if any) shall be in compliance with national and local codes pertaining to plenum environments. It is the responsibility of the Contractor to review the VA's cable and wire requirements with the RE and the IRM prior to installation to confirm the type of environment present at each location.
- 6) The Contractor shall provide outside and inside plant cables that furnishes the number of cable pairs required in accordance with the System requirements described herein. The Contractor shall fully coordinate and obtain approval of the design with the OEM, RE and the IRM prior to installation.
- 7) All metallic cable sheaths, etc. shall be grounded by the Contractor (i.e.: risers, underground, station wiring, etc.) as described herein.
- 8) If temporary cable and wire pairs are used, they shall be installed so as to not present a pedestrian safety hazard and the Contractor shall be responsible for all work associated with the temporary installation and for their removal when no longer necessary. Temporary cable installations are not required to meet Industry Standards; but, must be reviewed and approved by the RE and the IRM prior to installation.
- 9) Conductors shall be cabled to provide protection against induction in voice and data, and analog RF circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.
- 10) Measures shall be employed by the Contractor to minimize the radiation of RF noise generated by the System equipment so as not to interfere with audio, video, data, computer main distribution frame (MDF), telephone customer service unit (CSU), and electronic private branch exchange (EPBX) equipment the System may service.

- 11) The System's cables shall be labeled on each end and been fully tested and certified in writing by the Contractor to the RE before proof of performance testing can be conducted. The as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs. Minimum test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on all cables in the frequency ranges specified. The tests required for data cable must be made to guarantee the operation of this cable at not less than 10 mega (m) Hertz (Hz) full bandwidth, fully channel loaded and a Bit Error Rate of a minimum of 10^{-6} at the maximum rate of speed. All cable installation and test records shall be made available at acceptance testing by the COTR or Contractor and thereafter maintained in the Facility's Telephone Switch Room. All changes (used pair, failed pair, etc.) shall be posted in these records as the change occurs.
- 12) The Contractor shall coordinate with the LEC to install the telephone entrance cable to the nearest point of entry into the Project Area and as shown on the drawings. The Contractor shall coordinate with the RE and the LEC to provide all cable pairs/circuits from the Existing Facility Riser to the Telephone Switch Room all telephone, FTS, DHCP, ATM, Frame Relay, data, pay stations, patient phones, and any low voltage circuits as described herein.
- 13) The Contractor shall coordinate with the RE and the IRM or to install the computer interface cable to the Facility Telephone Switch Room from the Facility's Computer Room for all data, DHCP, FTS, ATM, Frame Relay, and telephone circuits and as shown on the drawings.
- 14) The Contractor shall coordinate with the RE and the IRM or to provide all cable pairs/circuits from the Facility Telephone Switch Room and establish circuits to the Project Area for all voice, data, computer alarm (except fire alarm), private maintenance line, Radio Paging, PA, LAN, DHCP, and any low voltage circuits as described herein.
- 15) The Contractor shall provide proper test equipment to guarantee that cable pairs and analog RF coaxial cable meet

each OEM's standard transmission requirements, and guarantee the cable will carry data transmissions at the required speeds, frequencies, and fully loaded bandwidth.

- 16) The Contractor shall coordinate with the Facility Chief of Medical Media Production Service (MMPS) to install baseband analog RF, video, and audio interface cables and circuits from each TC to designated TCO locations and as shown on the drawings. The Contractor shall work with the Facility Chief of MMPS to establish circuits throughout the Facility and shall provide proper test equipment to guarantee that analog RF, video, and audio cables meet each OEM's standard transmission requirements, and guarantee the cables will carry analog video and audio transmissions at the required speeds, frequencies, and fully loaded bandwidth.
- b. Telecommunications Closets (TC): In TC's that are served with both a UTP And STP backbone cable and a fiber optic backbone cable, the UTP and STP cable shall be terminated on separate RJ-45, 8-pin connectors with 110A or equivalent type punch down blocks located on the back or front of a 48-port modular patch panel dedicated to data applications. Only the UTP and STP backbone cable pairs, identified as being connected to the fiber optic backbone, shall be extended to the fiber optic interface device. All connecting cables required to extend these cables (i.e. patch cords, twenty-five pair connectors, etc.), to the fiber optic interface device, in the TC's shall also be provided by the Contractor to insure a complete and operational fiber optic distribution system:
 - 1) In TC's, which are only served by a UTP and STP backbone cable, the cable shall be terminated on separate modular connecting devices (110A or equivalent) that are dedicated to data applications. In order to provide full service to all data cable pairs as identified in each TC/cabinet including spare capacity noted herein, the size of all vertical (riser) cables and/or outside cables serving these TC's shall be increased as required.
- c. Backbone and Trunk Cables:
 - 1) The Contractor shall identify, in the technical submittal, the voice and data (analog RF coaxial cable shall not be provided

in main trunk or backbone lines) connecting arrangements required by the LEC for interconnection of the System to the commercial telephone and FTS networks. The Contractor shall provide all required voice and data connecting arrangements.

- 2) The Contractor shall be responsible for compatibility of the proposed TCs (to be compliant with the EPBX and CSU equipment) numbering scheme with the numbering plan for the FTS, DID, local stations, and the North American Numbering Plan. The Contractor shall consult with the VA and the LEC regarding the FTS and North American Numbering plan to be implemented for the Facility to ensure system compatibility.
- 3) All submitted equipment shall meet or exceed standards, rules, and regulations of the Federal Communications Commission (FCC) and shall be capable of operating without outboard or "extra" devices. The Contractor shall identify the FCC registration number of the System equipment, EPBX, and proposed CSU (if known) in the technical submittal.

d. Riser Cable:

- 1) All communication riser cables shall be listed as being suitable for the purpose and marked accordingly per Articles 517, 700, and 800 of the NEC.
- 2) All voice and data communication (analog RF coaxial cable is not to be provided in riser systems) riser cables shall be STP or Unshielded Twisted Pair (UTP), minimum 24 American Wire Gauge (AWG) solid, thermoplastic insulated conductors. They shall be enclosed with a thermoplastic outer jacket.
- 3) The Contractor shall provide and install inside riser cables to insure full service to all voice cable pairs identified in each TC terminating enclosure plus not less than 50% additional spare capacity.
- 4) The complete riser cabling system shall be labeled and tested as described herein.

e. Horizontal and Station Cable:

- 1) A Four (4) UTP 24 AWG station wiring cable shall be installed from the top TCO jack to the TC and shall be of a type designed to support Category 6 communications (250 mega-Hertz [mHz] or above). At the jack location, terminate all four pair

on the RJ-45/11 jack. At the signal closet, all four pair shall be terminated on the modular punch down block.

- 2) A Four (4) UTP 24 AWG (in thermoplastic jacket unless otherwise specified by RE) station wiring cable shall be installed from each of the two (2) bottom TCO RJ-45 jacks (shall conform to EIA/TIA 568 Standard "T568A" and NFPA) to the TC and shall be of a type designed to support Category 6 communications (250 MHz or above).

f. Patient Information Monitor Cable:

- 1) One UTP 24 AWG station wiring cable shall be installed from the top Single Port TCO jack to the TC and shall be of a type designed to support Category 6 communications (250 mega-Hertz [mHz] or above). At the jack location, terminate all four pair on the RJ-45/11 jack. At the signal closet, all four pair shall be terminated on the modular punch down blocks.
- 2) A Four (4) UTP 24 AWG (in thermoplastic jacket unless otherwise specified by RE) station wiring cable shall be installed from each of the Single Port TCO RJ-45 jacks (shall conform to EIA/TIA 568 Standard "T568A" and NFPA) to the TC and shall be of a type designed to support Category 6 Data communications (250 MHz or above).

g. Telecommunication Outlets (TCO), Jacks: All TCO's shall have a minimum of three (3) RJ-45 type jacks. The top jack shall be an eight pin RJ-45/11 compatible jack, labeled, and designated for telephone applications only. The bottom two jacks shall be eight pin RJ-45 type unkeyed (sometimes called center keyed) jacks, labeled, and designated for data.

h. Patient Information Monitor Single Port TCO outlet, Jack: shall have one (1) RJ-45 type jacks. The jacks shall be eight pin RJ-45 type unkeyed (sometimes called center keyed) jacks, labeled, and designated for data.

i. Patient Bedside Prefabricated Units (PBPU): Where PBPU's exist in the Facility, the Contractor shall identify the single gang "box" location on the PBPU designated for installation of the telephone jack. This location shall here-in-after be identified as the PBTCO. The Contractor shall be responsible for obtaining written approval and specific instructions from the PBPU OEM regarding the necessary disassembly and reassembly of each PBPU to the

extent necessary to pull wire from above the ceiling junction box to the PBPU box reserved for the PBTCO. A Contractor provided stainless steel cover plate approved for use by the PBPU OEM and Facility IRM Chief shall finish out the jack installation. Under no circumstances shall the Contractor proceed with the PBPU installations without the written approval of the PBPU OEM and the specific instructions regarding the attachment to or modifying of the PBPU. The COTR shall be available to assist the Contractor in obtaining these approvals and instructions in a timely manner as related to the project's time constraints. It is the responsibility of the Contractor to maintain the UL integrity of each PBPU. If the Contractor violates that integrity, it shall be the responsibility of the Contractor to obtain on site UL re-certification of the violated PBPU at the direction of the RE and at the Contractor's expense.

j. Fiber Optics:

- 1) A fiber optic cable distribution system shall be provided as a part of the System. The Contractor shall provide a fiber optic cable that meets the minimum bandwidth requirements for FDDI, ATM, and Frame Relay services. This fiber optic cable shall be a 62.5/125 Multi-mode and 9/125 Single-Mode, containing a minimum of 12 - (1) one pair of fiber (24 Strands fiber), unless otherwise specified, and shall not exceed a distance of 2,000 Meters (M), or 6,560 feet (ft.) in a single run. Tight buffered fiber cable shall be used for indoor runs. The multimode fibers shall be terminated and secured at both ends in "ST" type female stainless steel connectors installed in an appropriate patch or breakout panel with a cable management system. A 610 mm (2 ft.) cable loop (minimum) shall be provided at each end to allow for future movement.
- 4) The fiber optic backbone shall use a conventional hierarchical "star" design where each TC is wired to the primary hub (main cross-connect system) or a secondary hub (intermediate cross-connect system) and then to the primary hub. There shall be no more than two hierarchical levels of cross-connects in the backbone wiring. Each primary hub shall be connected and terminated to a CCS in the Telephone Switch Room. Additionally, a parallel separate fiber optic interconnection

shall be provided between the Telephone Switch Room CCS and the MDF in the Main Computer Room.

- 5) In the TC's, Telephone Switch Room, and Main Computer Room, all fiber optic cables shall be installed in a CCS and/or MDF rack mounted fiber optic cable distribution component/splice case (Contractor provided and installed rack), patch, or breakout panel in accordance with industry standards. Female "ST" connectors shall be provided and installed on the appropriate panel for termination of each strand.
 - 6) The Contractor shall test each fiber optic strand. Cable transmission performance specifications shall be in accordance with EIA/TIA standards. Attenuation shall be measured in accordance with EIA fiber optic test procedures EIA/TIA-455-46, -61, or -53 and NFPA. Information transmission capacity shall be measured in accordance with EIA/TIA-455-51 or -30 and NFPA. The written results shall be provided to the RE for review and approval.
3. Specific Subsystem Requirements: The System shall consist, as a minimum, of the following independent sub-systems to comprise a complete and functional voice and digital and analog RF telecommunications cabling system: "Main" (MTC), "intermediate" (IMTC), and "riser" (RTC) TC's; "backbone" cabling (BC) system; "vertical" (or "riser") trunk cabling system; "horizontal" (or "lateral") sub-trunk cabling system, vertical and horizontal cross-connection (VCC and HCC respectively) cabling systems, and TCO's with a minimum of three (3) RJ-45 jacks for the appropriate telephone, Data connections, and additional jacks, connectors, drop and patch cords, terminators, and adapters provided.
- a. Telecommunication Closet (TC):
- 1) There shall be a minimum of one TC for the MTC, each building IMTC, and each RTC per building floor location. However, in large building(s), where the horizontal distance to the farthest voice and digital work area may exceed 90 Meters (M) (or 295 feet [ft]), additional TC's shall be provided as described herein. The maximum DC resistance per cable pair shall be no more than 28.6 Ohms per 305 M (1,000 feet). Each TC shall be centrally located to cover the maximum amount of local floor space. The TC's house in cabinets or enclosures,

on relay racks, and/or on backboards, various telecommunication data equipment, controllers, multiplexers, bridges, routers, LAN hub(s), telephone cross-connecting, active and passive equipment.

- 2) Separate TC's shall house fire alarm, nurses call, code blue, video, public address, radio entertainment, intercom, CCTV, Security and radio paging equipment. Regardless of the method of installation, mounting, termination, or cross-connecting used, all backbone, vertical, and horizontal copper and fiber optic and analog RF coaxial cables shall be terminated on appropriate cross-connection systems (CCS) containing patch panel(s), punch blocks, and/or breakout devices provided in enclosures and tested as described herein. A cable and/or wire management system shall be a part of each CCS.

- a) A minimum of three 110-120 VAC active quad outlets shall be provided, each with "U" grounded receptacles at a minimum of one outlet for each front, side and back wall. These outlets shall be separately protected by an AC circuit breaker provided in the designated Government Emergency Critical Care AC power panel, that is connected to the Facilities Emergency AC Power Distribution System. For larger building TC applications, a minimum of one additional quad AC outlet shall be provided for every 800M² (or 8,000 ft²) of useable floor space. Additional outlets shall be equally spaced along the wall.

- b) Climate control shall be provided in each TC 24 hours a day, seven days per week and 52 week per year to prevent failure of electronic components and for mission critical functional applications. The RE and/or Facility Chief Engineering Officer are responsible for informing the Contractor regarding the minimum climate control requirements. In identified hostile TC locations where it has been determined (by the RE or Facility Chief Engineer) that proper TC climate or external signal radiation cannot be properly maintained or controlled, the Contractor may, at his/her option, provide a minimum of two individual and properly sized self contained climate controlled equipment

cabinet enclosures; one designated for voice, and one designated for data , and one additional cabinet designated for analog RF service, in each TC location identified on the drawings, in lieu of providing additional required TC air handling capability.

b. Cross-connect Systems (CCS):

- 1) The CCS shall be selected based on the following criteria:
requires the use of a single tool, has the fewest amount of parts, and requires the least amount of assembly or projected trouble shooting time during the life of the system.
- 2) The CCS system used at the MTC, each IMTC, and each TC shall force cross-connect cable slack management through adherence to the OEM's installation methods, provided cable management systems, and as described herein, so that moves, adds, and changes can be administered easily and cost effectively.
- 3) Copper Cables: The MTC, each IMTC, and TC shall contain a copper CCS sized to support the System TCO's and connections served by each individual TC and as shown on the drawings. The System layout shall allow for a minimum of 50% anticipated growth. Additionally, each CCS must provide maximum flexibility, while maintaining performance, in order to meet system-changing requirements that are likely to occur throughout its useful life.
- 4) Fiber Optic Cables:
 - a) The MTC and each TC shall contain a fiber CCS sized to support the System TCO's and connections served by each individual TC and as shown on the drawings. The System layout shall allow for a minimum of 50% anticipated growth.
 - b) Each fiber CCS must provide maximum flexibility and cable management while maintaining performance in order to meet changing requirements that are likely to occur throughout the expected life of the system. All fiber optic cable slack shall be stored in protective enclosures.
 - c) If it is determined that a fiber optic distribution system is not necessary for the immediate system needs. Each TC shall be provided with fiber optic cable(s) that contain a minimum of 12 - (1) one Pair (or 24 Fibers) "dark"

multimode fiber and 12 - (1) one Pair (or 24 Fibers) Single multimode fiber, each fiber properly terminated on its respective female stainless steel connector mounted in an appropriate fiber termination enclosure provided in each TC.

- 5) The Contractor shall not "cross-connect" the copper or fiber optic cabling systems and subsystems even though appropriate "patch" cords are to be provided for each "patch", "punch", or "breakout" panel. In addition, the Contractor shall not provide active electronic distribution or interface equipment as a part of the System.
- 6) Grounding: Proper grounding and bonding shall be provided for each TC and all internal equipment. Reference shall be made to proper codes and standards, such that all grounding systems must comply with all applicable National, Regional, and Local Building and Electrical codes. The most stringent code of these governing bodies shall apply.
 - a) If local grounding codes do not exist for the System location, then at a minimum, a #6 American Wire Gauge (AWG) stranded copper wire, or equivalent copper braid, shall be connected to a separate earth grounding system for each TC (the looping of TC's in a general location is allowed as long as the specifications contained herein are met). Under no circumstance shall the AC neutral be used for this ground. See PART 3 - EXECUTION for specific grounding instructions.
 - b) Each copper UTP or STP cable that enters a TC from the outside of a building (regardless if the cable is installed underground or aerial) shall be provided with a surge protector and grounded an to earth ground at each cable's entry point in and out of the MTC and each IMTC.
- c. Main Cross-connection Subsystem (MCCS): The MCCS shall be located in the MTC and it shall be the common point of appearance for inter and intra-building copper and fiber optic "backbone" system cables, and connections to the telephone and data cable systems. The MTC usually houses telephone EPBX, public address, radio paging interface, routers, and main hierarchical data LAN

concentrating equipment. Additionally, it shall provide a single administration and management point for the entire System.

d. Voice (or Telephone) Cable Cross-Connection Subsystem:

- 1) Due to the usually high number of copper cable termination's required at the MCCS, Insulation Displacement Connection (IDC) hardware shall be used. Termination options shall include the following for a Category 6 Cabling System: IDC termination of cross-connection wire(s), IDC patch cord connector to IDC patch cord connector, and hybrid modular cord to IDC patch cord connector shall be the minimum provided.
- 2) Additionally, due to the large or many MCCS (at initial installation and over the life of the System) copper termination points, the CCS that makes the best use of real estate while still following the OEM design and installation guidelines, and meeting the specifications described herein, shall be provided.
- 3) For ease of maintenance purposes, all terminations shall be accessible without the need for disassembly of the IDC wafer. IDC wafers shall be removable from their mounts to facilitate testing on either side of the connector. Designation strips or labels shall be removable to allow for inspection of the terminations. The maximum number of terminations on a wall or on a rack frame or panel shall comply with the OEM recommendations and guidelines, and as described herein. A cable management system shall be provided as a part of the IDC.
- 4) IDC connectors shall be capable of supporting cable re-terminations without damaging the connector and shall support a minimum of 200 (telephone equipment standard compliant) IDC insertions or withdrawals on either side of the connector panel.
- 5) A non-impact termination method using a full-cycle terminating tool having both a tactile and an audible feedback to indicate proper termination is required. For personnel safety and ease of use in day to day administration, high impact installation tools shall not be used.
- 6) All system "inputs" from the EPBX, FTS, Local Telephone System, or diverse routed voice distribution systems shall

appear on the "left" side of the IDC (110A blocks with RJ45 connections are acceptable alternates to the IDC) of the MCCS.

- 7) All system "outputs" from the MCCS to the voice backbone cable distribution system shall appear on the "right" side of the same IDC (or 110A blocks) of the MCCS.
 - 8) The splitting of pairs within cables between different jacks or connections shall not be allowed. In the case of ISDN and/or ATM and /or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
 - 9) UTP or STP cross connecting wires shall be provided for each "pair" of connection terminals plus an additional 50% spare.
- e. Data Cross-Connection Subsystems:

- 1) The MCCS shall be a Main Distribution Terminating (MDT) data unit and shall be provided in the MTC. The MDT shall consist of a "patch" panel(s) provided with modular RJ45 female connectors for cross-connection of all copper data cable terminations. The panels shall provide for system grounding (where no dielectric cables are used) and be provided with a cable management system.
- 2) Each panel shall conform to EIA dimensions and be suitable for mounting in standard equipment racks, have the RJ45 jacks aligned in two horizontal rows (up to a maximum of 48 jacks per panel), and shall not exceed the OEM's recommendations. Each RJ45 jack shall be of modular design and capable of accepting and functioning with other modular (i.e. RJ11) plugs without damaging the jack. It is not necessary to provide a jack for unused positions that are not part of the 50% expansion requirement.
 - a) All data system inputs from the server(s), data LAN, bridge, or interface distribution systems shall appear on the "top" row of jacks of the appropriate patch panel.
 - b) All System outputs or backbone cable connections shall appear on the "bottom" row of jacks of the same patch panel.
 - c) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and/or Frame Relay applications, terminating resistors

shall be provided externally to the patch panel connector or jack.

- 3) A patch cord shall be provided for each system "pair" of connection jacks. Each patch cord shall have modular RJ45 connectors provided on each end to match the panel's modular RJ45 female jack's being provided.
- f. Fiber optic Cross-Connection Subsystems: The MTC shall be provided with a separate fiber MCCS. Each TC shall be provided with a rack mounted patch or distribution panel that is installed inside a lockable cabinet or "breakout enclosure" that accommodates a minimum of 12 pair multimode fiber and 12 pair singlemode fiber (these counts shall not be included the 50% spare requirement).
- 1) The panel(s) shall contain a minimum of 24 female "ST" connectors, be able to accommodate splices and field mountable connectors and have capacity for additional connectors to be added up to the OEM's maximum standard panel size for this type of use. All patch panel sides, including the front and back, shall be protected by a cabinet or enclosure.
 - 2) The panel(s) shall conform to EIA dimensions and be suitable for installation in standard racks, cabinets, and enclosures. The panels shall provide for system grounding (where no dielectric cables are used).
 - 3) The patch panel with the highest OEM approved density of fiber "ST" termination's (maximum of 72 each), while maintaining a high level of manageability, shall be selected. Patch cables, with proper "ST" connectors installed on each end shall be provided for each pair of fiber optic cable "ST" connectors.
 - a) All System "inputs" from interface equipment or distribution systems shall appear on the "top" row of connectors of the appropriate patch panel.
 - b) All System "outputs" or backbone cable connections shall appear on the "bottom" row of connectors of the same patch panel.
 - 4) In order to achieve a high level of reliability that approximates that of an OEM connector, field installable connectors shall have an OEM specified physical contact polish. Every fiber cable shall be terminated with the

appropriate connector, and tested to ensure compliance to OEM and specifications outlines herein. Where a local fiber optic system connector standard, Industry Standard fiber optic "ST" female connector terminated with a fiber optic cable, shall be used. But, if the fiber optic cable is not used (or "dark"), a "ST" male terminating "cap" shall be provided for each unused "ST" female connector.

- g. Intermediate Cross-connection Subsystems (IMCCS): The MTC and each IMTC shall be provided with an IMCCS that shall be the connection point between the MCCA system and the distribution backbone cable and the IMCCS, that is located in one or more buildings on a campus, where each IMCCS is placed by system design. For a technical explanation of internal equipment and system requirements, refer to the above MTC and MCCA paragraphs.
- h. Distribution (Common to Intra-Building) Cabling Systems: The intra-building trunk cabling system provides for connection between the IMCCS and each Riser TC's provided vertical cross-connecting system (VCCA) within a building. The media (copper, fiber optic, and RF coaxial) used in the intra-building backbone cabling system shall be designed according to the system requirements, OEM standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic, and analog RF coaxial trunk system shall be provided as a part of the System.
 - 1) Category 6 UTP or STP multi-pair trunk cable(s) shall be used in the voice and data trunk-line-cabling systems. A minimum of eight pairs per circuit, plus an additional 50% spare for growth shall be provided.
 - 2) Where the distance limitations of UTP and/or STP will be exceeded, multimode and single mode fiber optic cable shall be used in the data and/or trunk cabling systems. The total loss of the fiber trunks shall not exceed 12 dB at 850 nM , 11 dB at 1,300 nM, or 10 dB at 1,500 nM.
 - a) All voice system "outputs" from the IMCCS to the trunk-line distribution system shall appear on the "right" side of IDC (minimum 110A blocks) punch terminals of the IMCCS.

- b) All data system "outputs" from the IMCCS to the trunk-line distribution system shall appear on the "bottom" row of jacks of the same IDC (minimum 110A blocks) of the IMCCS.
 - c) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and/or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
 - d) A patch cord shall be provided for each system "pair" of connection jacks. Each patch cord shall have modular connectors provided on each end to match the panel's modular female jack.
- 3) The fiber optic trunk line system shall be configured as a "Buss" Topology with separate dedicated fibers between the IMCCS and each RCS. The System shall be sized to meet the System requirements with a expansion capability of 50% provided. Separate individual fiber optic cable(s) with a minimum of 12 - (1) pair multimode fiber and 12 - (1) pair singlemode fiber shall be provided.
- 4) All trunk lines shall be identified with permanent labels at both ends. Labels will indicate system, floor, closet, and zone. The label designations shall match those used for cross-connects and patch panels.
- a) All System outputs from the IMCCS to the trunk-line distribution system shall appear on the "bottom" row of "ST" connectors in the appropriate patch panel.
 - b) A patch cord shall be provided for each system "pair" of connection "ST" connectors. As a minimum, each patch cord shall have "ST" male connectors provided on each end to match the panel's female "ST" connector provided.
- 5) An analog RF coaxial cable trunk system shall be provided. A minimum of two coaxial cables shall be provided between the IMCCS and each Riser VCCS to comprise an individual circuit as designated and as shown on the drawings. Additional analog RF coaxial cables shall be provided as system design dictates and as shown on the drawings.
- 6) The analog RF coaxial trunk-line systems shall be connected between each IMCCS "bottom" row of "F" connectors and shall

terminate on the VCCS "top" row of "F" connectors on an appropriate patch panel. A minimum of six coaxial cables shall be provided in the riser trunk-line system.

- j. VCCS and Horizontal Cross-connecting (HCCS) Systems: Each TC shall be provided with a separate VCCS and HCCS located within the TC. The VCCS and HCCS shall interconnect and interface the riser (vertical) trunk line cables with the horizontal (or station) sub-trunk line cables. The media (copper, fiber optic and analog RF coaxial used in the CCS system shall be designed according to the System requirements, OEM standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic and RF coaxial CCS system shall be provided as a part of the System.
- 1) The UTP, STP, and fiber optic and RF coaxial trunk-line cabling systems are that connected between the trunk-lines and Riser VCCS, shall be terminated:
 - a) On the "left" or "top" IDC (or 110A blocks) for each UTP or STP voice cable.
 - b) On the "top" row of RJ45 jacks on the appropriate patch panel for each UTP or STP data cable.
 - c) On the "top" row of "ST" connectors on the appropriate patch panel for each fiber and "F" connectors for each analog RF coaxial cable.
 - 2) The UTP, STP, and fiber optic and analog RF coaxial sub-trunk (lateral) floor distribution cabling systems that are connected between each RTC and each TCO or secondary system distribution or connection point, shall terminate on an appropriate HCCS, at the:
 - a) On the "right" IDC (or 110A block) used as the VCCS input for each UTP or STP voice cable.
 - b) On the "bottom row of RJ45 jacks on the appropriate patch panel used as the VCCS input for each UTP or STP data cable.
 - c) On the "bottom" row of "ST" connectors on the appropriate patch panel used as the VCCS input for each fiber and "F" connectors for each analog RF coaxial cable.
 - d) The technical requirements of the VCCS and HCCS "patch", "terminating", or "breakout" panels and cable management

assemblies for voice, data and fiber optic (and RF coaxial) cables shall be as described in the above MCCS, IMCCS, and TC technical paragraphs.

- 3) The Contractor shall not "cross-connect" the VCCS or HCCS cabling systems even though appropriate patch cords are provided for each "patch", "punch", or "breakout" panel. Also, the Contractor shall not provide active interface or distribution electronic equipment as a part of the System.
- k. Horizontal (or Station) Cabling (HC): The HC distribution cabling systems connects the distribution field of the voice and data HCCS, in a "Star" Topology, to each TCO or connector and as shown on the drawings via the sub-trunk system.
 - 1) Horizontal cables shall consist of insulated, UTP or STP conductors that are rated for Category 6 telecommunications service for voice and data systems.
 - 2) The number of UTP or STP distribution pairs dedicated to each floor from the HC shall be sufficient to accommodate all the horizontal voice and data circuits served by the distribution cable to each TCO.
 - a) A minimum of four pairs for voice shall be connected to the "right" side of the IDC (or 110A block) that the VCCS "input" connections appear in the RTC.
 - b) A minimum of two separate sets of four pairs each for data shall be connected to the "bottom" row of RJ45 jacks that the VCCS "input" connections appear in the RTC.
 - 3) The horizontal cable length to the farthest system outlet shall be limited to a maximum of 90M (or 295 ft). These maximum lengths must be derated, adjusted and reduced to include cross-connection and distribution system losses. Additional TC(s) shall be provided on large floor areas of buildings to limit the horizontal distribution to a maximum of 90M (or 295 ft).
 - 4) The splitting of pairs within a cable between different jacks shall not be permitted.
 - 5) The installation of the HC shall conform to appropriate OEM recommendations and standards outlined herein. This requirement will insure adequate protection for Electro-Magnetic Interference (EMI) sources.

- 6) A system design where "looping" the HC distribution cables from room to room shall not be permitted.
- 7) The number of fiber optic cables dedicated from the "bottom" row of "ST" connectors of the appropriate patch panel that the VCCS "input" connections were made, to each IDF shall be sufficient to accommodate all the horizontal TCO's served by the distribution cable system in a "home run" configuration as shown on the drawings.
- 8) The analog RF coaxial cables dedicated from the "bottom" row of "F" connectors of the appropriate VCCS patch panel where the "input" connections were made, to each floor TCO shall provided in the "home run" configuration and be sufficient to accommodate all the TCO's served by the HC distribution cable system minimum of one or analog RF coaxial cable shall be provided for each TCO circuit and as shown on the drawings).
1. System Telecommunication Outlets (TCO): The System shall be capable of receiving the specified telephone (or voice) and data signals acquired from the LEC, FTS contracted carrier and computer system, and one each analog RF cable and one each fiber optic single mode and multimode cables and shall process and distribute them to the designated TCO's and as shown on the drawings. At a minimum, one TCO shall be provided on each room wall, associated with an active 120 VAC shall be provided and as shown on the drawings. The only exception to the general rule, of one outlet per wall, shall be those "special" locations (e.g., surgical suites, radiology MRI rooms, labs, patient bed rooms, warehouse, loading docks, storage rooms, etc.) where there is usually only one TCO provided as designated on the drawings.
 - 1) Each TCO shall consist of three multipin modular RJ45 jacks, one designated for telephone and two for data service, and two fiber optic "ST" connectors, one designated for multimode fiber optic cable and the other for single mode fiber optic cable connection(s) and one analog RF coaxial "F" connector. Each TCO with appropriate jacks installed shall be provided by the Contractor in each designated location and as shown on the drawings.
 - 2) The Contractor shall connect each telephone multipin modular RJ45 jack to a separate "right side as you look at it"

telephone HC distribution system HCCS "punch down" 110A block or approved IDC terminating device in each associated RTC. The modular RJ45 jack shall be able to accept and operate with smaller modular RJ11 plugs while providing proper connection and not damaging the modular jack. The OEM shall warrant all modular RJ45/11 jacks in such a manner to be usable for modular RJ11 plugs.

- 3) The Contractor shall connect each TCO data multipin modular RJ45 jack to a separate lower row jack on the HCCS "patch panel" in each associated RTC. The Contractor is not to "cross-connect" VCCS and HCCS data distribution cables or provides active electronic data distribution equipment as a part of the System.
- 4) A non-impact termination method, using either a stuffer cap with installation tool or full-cycle terminating tool having both tactile and audible feedback to indicate proper termination shall be used. High impact installation tools shall not be used.
- 5) Each terminated conductor end shall be properly trimmed to assure a minimum clearance of 6.35 mm (0.250 in) clearance between the conductors of adjacent modules.
- 6) The multipin RJ45 jack shall be modular in construction that will accept and operate with a modular UTP and STP RJ45 connector and its pin assignments.
- 7) The Contractor shall connect each fiber optic TCO "ST" connector to a separate fiber optic "bottom" row "ST" connector HCCS "patch panel" or "breakout" terminating device in each associated TC. The Contractor is not to "interconnect" VCCS and HCCS fiber optic distributions cables or provide active fiber optic electronic distribution equipment as a part of the system.
- 8) The Contractor shall connect each analog RF cable to a female "F" connector provided on each TCO and as shown on the drawings and to each bottom row of "F" connectors on the HCCS patch panel(s) serving the area. The Contractor is not to "interconnect" VCCS and HCCS analog RF distribution cables OR provides active analog RF distribution equipment as a part of the System.

B. System Performance:

1. At a minimum, the System shall be able to support the following voice and data and analog RF operations for Category 6 Certified Telecommunication Service:
 - a. Provide the following interchange (or interface) capabilities:
 - 1) Basic Rate (BRI).
 - a) B Channel: 64 kilo-Bits per second (kBps), minimum.
 - b) D Channel: 16 kBps, minimum.
 - c) H Channel: 384 kBps, minimum.
 - 2) Primary Rate (PRI).
 - a) B Channel: 64 kBps, minimum.
 - b) D Channel: 64 kBps, minimum.
 - c) H Channel: 1,920 kBps, minimum.
 - b. ISDN measured
 - 1) Narrow Band BRI.
 - a) B Channel: 64 kilo-Bits per second (kBps), minimum.
 - b) D Channel: 16 kBps, minimum.
 - c) H Channel: 384 kBps, minimum.
 - 2) Narrow Band PRI:
 - a) B Channel: 64 kBps, minimum.
 - b) D Channel: 64 kBps, minimum.
 - c) H Channel: 1,920 kBps, minimum.
 - 3) Wide (or Broad) Band:
 - a) All channels: 140 mega(m)-Bps, minimum, capable to 565 mBps at "T" reference.
 - c. ATM operation and interface: ATM 155 mBps measured
 - d. Frame Relay: All stated compliance's measured
 - e. Integrated Data Communications Utility (IDCU) operation and interface: Measured
 - d. Government Open Systems Interconnection Profile (GOSSIP) compliant: Measured
 - e. Fiberoptic Distributed Data Interface (FDDI): A minimum 100 mBps to a maximum of 1.8 giga(g)-Bps data bit stream speed measured (shall be Synchronous Optical Network [Sonet] compliant).
 - f. System Sensitivity: Satisfactory service shall be provided for at least 3,000 feet for all voice and data and analog RF locations.
2. At a minimum the System shall support the following operating parameters:
 - a. EPBX connection:
 - 1) System speed: 1.0 gBps per second, minimum.
 - 2) Impedance: 600 Ohms.
 - 3) Cross Modulation: -60 deci-Bel (dB).
 - 4) Hum Modulation: -55 Db.

- 5) System data error: 10 to the -10 Bps, minimum loss measured at the frame output with reference Zero (0) deciBel measured (dBm) at 1,000 Hertz (Hz) applied to the frame input.
 - a) Trunk to station: 1.5 dB, maximum.
 - b) Station to station: 3.0 dB, maximum.
 - c) Internal switch crosstalk: -60 dB when a signal of ± 10 deciBel measured (dBm), 500-2,500 Hz range is applied to the primary path.
 - d) Idle channel noise: 25 dBm "C" or 3.0 dBm "O" above reference (terminated) ground noise, whichever is greater.
 - e) Traffic Grade of Service for Voice and Data:
 - (1) A minimum grade of service of P-01 with an average traffic load of 7.0 CCS per station per hour and a traffic overload in the data circuits will not interfere with, or degrade, the voice service.
 - (2) Average CCS per voice station: The average CCS capacity per voice station shall be maintained at 7.0 CCS when the EPBX is expanded up to the projected maximum growth as stated herein.
- b. Telecommunications Outlet (TCO):
 - 1) Voice:
 - a) Isolation (outlet-outlet): 24 dB.
 - b) Impedance: 600 Ohms, balanced (BAL).
 - c) Signal Level: 0 deciBel per mili-Volt (dBmV) ± 0.1 dBmV.
 - d) System speed: 100 mBps, minimum.
 - e) System data error: 10 to the -6 Bps, minimum.
 - 2) Data:
 - a) Isolation (outlet-outlet): 24 dB.
 - b) Impedance: 600 Ohms, BAL.
 - c) Signal Level: 0 dBmV ± 0.1 dBmV.
 - d) System speed: 120 mBps, minimum.
 - e) System data error: 10 to the -8 Bps, minimum.
- c. Other outlets and feeds:
 - 1) Fiber optic:
 - a) Isolation (outlet-outlet): 36 dB.
 - b) Signal Level: 0 dBmV ± 0.1 dBmV.
 - c) System speed: 540 mBps, minimum.

- d) System data error: 10 to the -6 BPS, minimum.
- 2) Analog RF Service: Broadcast or "off air" RF (or television) analog service is considered to be at RF (below 900 MHz in frequency bandwidth). Usually a RF television circuits require a single coaxial cable plant from the headend to each TC location.
 - a) Isolation (outlet-outlet): 14 dB.
 - b) Impedance: 75 Ohms, Unbalanced (UNBAL).
 - c) Signal Level: 10 dBmV \pm 5.0 dBmV.
 - d) Bandwidth: 6.0 MHz per channel, fully loaded/
- 3) Closed Circuit Analog Video Service: Analog video service is considered to be at baseband (below 100 MHz in frequency bandwidth). An analog video circuit requires a separate analog video from the audio connector. The following minimum operating parameters shall be capable over each installed analog video circuit:
 - a) Impedance: 75 Ohm, unbalanced.
 - b) Output Level: 1.0 V peak to peak (P-P), for 87.5% depth of Modulation (Mod).
 - c) Diff Gain: \pm 1 dB at 87.5% Mod.
 - d) Diff Phase: \pm 1.5 at 87.5% Mod.
 - e) Signal to Noise (S/N) ratio: 44 dB, minimum.
 - f) Hum Modulation: -55 dB.
 - g) Return Loss: -14 dB (or 1.5 Voltage Standing Wave Ratio [VSWR]), maximum.
 - h) Isolation (outlet-outlet): 24 dB, minimum.
 - i) Bandwidth: 6.0 MHz per channel, fully loaded, minimum.
- 4) Closed Circuit Analog Audio Service: Analog audio service is considered to be at baseband (below 10 MHz in frequency bandwidth). Usually an analog audio circuit requires separate audio connectors and video connectors even though both are considered baseband signals. However, since each TCO has multiple 600 (or 120) Ohm BAL line pairs, the analog audio circuit may be designated to one of the provided pairs of UTP or STP for each TCO and as shown on the drawings, in lieu of providing a separate baseband audio run to the TCO. The

following minimum operating parameters shall be capable over each installed analog audio circuit:

a) Audio (NOT TELEPHONE VOICE):

- (1) Impedance: 600 Ohm, BAL.
- (2) Input Level: 59 mV Root Mean Squared (RMS), minimum.
- (3) Output Level: 0 dBm.
- (4) S/N ratio: 55 dB, minimum.
- (5) Hum Modulation: -50 dB, minimum.
- (6) Return Loss: -14 dB (or 1.5 VSWR), maximum.
- (7) Isolation (outlet-outlet): 24 dB, minimum.
- (8) Frequency Bandwidth: 100 Hz - 10K Hz, minimum.

C. General:

1. All equipment to be supplied under this specification shall be new and the current model of a standard product of an OEM or record. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:
 - a. Maintains a stock of replacement parts for the item submitted.
 - b. Maintains engineering drawings, specifications, and operating manuals for the items submitted.
 - c. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid.
2. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity, or performance characteristics of items furnished in the System. When the Contractor furnishes an item of equipment for which there is a specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.
3. The Contractor shall provide written verification, in writing to the RE at time of installation, that the type of wire/cable being provided is recommended and approved by the OEM. The Contractor is responsible for providing the proper size and type of cable duct and/or conduit and wiring even though the actual installation may be by another subcontractor.

4. The Telephone Contractor is responsible for providing interfacing cable connections for the telephone, PA and other necessary systems with the System.
5. The telephone equipment and PA interface equipment shall be the interface points for connection of the PA interface cabling from the telephone switch via the system telephone interface unit.
6. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC standards for telephone equipment, systems, and service.
7. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.
8. All interconnecting twisted pair, fiber-optic or coaxial cables shall be terminated on equipment terminal boards, punch blocks, breakout boxes, splice blocks, and unused equipment ports/taps shall be terminated according to the OEM's instructions for telephone cable systems without adapters. The Contractor shall not leave unused or spare twisted pair wire, fiber-optic, or coaxial cable unterminated, unconnected, loose or unsecured.
9. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, and this document, which ever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance. Reference Specification Section 27 10 00, STRUCTURED CABLING and Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT.
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. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the System OEM. Base- band cable systems shall utilize barrier terminal screw type connectors, at a minimum. Crimp type connectors installed with a ratchet type installation tool are and acceptable alternate

- as long as the cable dress, pairs, shielding, grounding, and connections and labeling are provided the same as the barrier terminal strip connectors. Tape of any type, wire nuts, or solder type connections are unacceptable and will not be approved.
12. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cycolac plastic for the areas where provided.
 13. 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.

D. Equipment Functional Characteristics:

FUNCTIONS	CHARACTERISTICS
Input Voltage	105 to 130 VAC
POWER LINE FREQUENCY	60 HZ \pm 2.0 HZ
Operating Temperature	0 to 50 degrees (°) Centigrade (C)
Humidity	80 percent (%) minimum rating

E. Equipment Standards and Testing:

1. The System has been defined herein as connected to systems identified as Critical Care performing Life Support Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Life Safety Codes (which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.
2. All supplies and materials shall be listed, labeled or certified by UL or a nationally recognized testing laboratory where such standards have been established for the supplies, materials or equipment. See paragraph minimum requirements Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, and the guidelines listed in paragraph 2.J.2.
3. The provided active and passive equipment required by the System design and approved technical submittal 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.

2.2 DISTRIBUTION EQUIPMENT AND SYSTEMS

A. Telecommunication Outlet (TCO):

1. The TCO shall consist of one telephone multipin jack and two data multipin jacks, mounted in a steel outlet box. A separate 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a labeled stainless steel faceplate will be used.
2. All telephone multipin connections shall be RJ-45/11 compatible female types. All data multipin connections shall be RJ-45 female types.
3. The TCO shall be fed from the appropriate CCS located in the respective RTC in a manner to provide a uniform and balanced distribution system.
4. Interface of the data multipin jacks to appropriate patch panels (or approved "punch down" blocks) in the associated RTC, is the responsibility of the Contractor. The Contractor shall not extend data cables from the RTCs to data terminal equipment or install data terminal equipment.
5. The wall outlet shall be provided with a stainless steel or approve alternate cover plate to fit the telephone multipin jack, data multi- pin jacks and the outlet box provided (100mm (4in.) x 100mm (4in.) for single and 100mm (4in.) x 200mm (8in.) for dual outlet box applications). For PBPU installations, the cover plate shall be stainless steel.

- ### **B. Distribution Cables:**
- Each cable shall meet or exceed the following specifications for the specific type of cable. Each cable reel shall be sweep tested and certified by the OEM by tags affixed to each reel. The Contractor shall turn over all sweep tags to the RE or PM. Additionally, the Contractor shall provide a 610 mm (2 ft.) sample of each provided cable, to the RE and receive approval before

installation. Cables installed in any outside location (i.e. above ground, under ground in conduit, ducts, pathways, etc.) shall be filled with a waterproofing compound between outside jacket (not immediately touching any provided armor) and inter conductors to seal punctures in the jacket and protect the conductors from moisture.

1. Remote Control:

- a. The remote control cable shall be multi-conductor with stranded (solid is permissible) conductors. The cable shall be able to handle the power and voltage necessary to control specified system equipment from a remote location. The cable shall be UL listed and pass the FR-1 vertical flame test, at a minimum. Each conductor shall be color-coded. Combined multi-conductor and coaxial cables are acceptable for this installation, as long as all system performance standards are met.

b. Technical Characteristics:

Length	As required, in 1K (3,000 ft.) reels minimum
Connectors	As required by system design
Size	18 AWG, minimum, Outside 20 AWG, minimum, Inside
Color coding	Required, EIA industry standard
Bend radius	10X the cable outside diameter
Impedance	As required
Shield coverage	As required by OEM specification
Attenuation	
Frequency in MHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
50.0	52.0

2. Telephone:

- a. The System cable shall be provided by the Contractor to meet the minimum system requirements of Category Six service. The cable shall interconnect each part of the system. The cable shall be completely survivable in areas where it is installed.
- b. Technical Characteristics:

Length	As required, in 1K (3,000 ft.) reels minimum
Cable	Voice grade category six
Connectors	As required by system design
Size	22 AWG, minimum, Outside 24 AWG, minimum, Inside
Color coding	Required, telephone industry standard
Bend radius	10X the cable outside diameter
Impedance	120 Ohms \pm 15%, BAL
Shield coverage	As required by OEM specification
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
62.0	52.0
100.0	68.0

3. Data Multi-Conductor:

- a. The cable shall be multi-conductor, shielded or unshielded cable with stranded conductors. The cable shall be able to handle the power and voltage used over the distance required. It shall meet Category Six service at a minimum.
- b. Technical Characteristics:

Wire size	22 AWG, minimum
Working shield	350 V
Bend radius	10X the cable outside diameter
Impedance	100 Ohms \pm 15%, BAL
Bandwidth	100 MHz, minimum
DC RESISTANCE	10.0 Ohms/100M, maximum
Shield coverage	
Overall Outside (if OEM specified)	100%
Individual Pairs (if OEM specified)	100%
Attenuation	
Frequency in MHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
62.0	52.0
100.0	68.0

4. Fiber Optic:

a. Multimode Fiber:

- 1) The general purpose multimode fiber optic cable shall be a dual window type installed in conduit for all system locations. A load-bearing support braid shall surround the inner tube for strength during cable installation.

2) Technical Characteristics:

Bend radius	6.0", minimum Outer jacket, As required
FIBER DIAMETER	62.5 MICRONS
Cladding	125 microns

Attenuation	
850 nM	3.5 dB per kM, maximum
1,300 nM	1.5 dB per kM, maximum
Bandwidth	
850 nM	160 mHz, minimum
1,300 nM	500 mHz, minimum
Connectors	Stainless steel
Fibers	12 pairs or 24 Fibers

a. Singlemode Fiber:

- 1) The general purpose Singlemode fiber optic cable shall be a dual window type installed in conduit for all system locations. A load-bearing support braid shall surround the inner tube for strength during cable installation.

2) Technical Characteristics:

Bend radius	4.0", minimum Outer jacket, As required
FIBER DIAMETER	8.7 MICRONS
Cladding	125 microns
Attenuation Premium Applications	
1,310/1,550 nM	1.0 dB per kM, maximum
Attenuation Outside plant applications	
1,310/1,550 nM	0.1 dB per kM, maximum
Connectors	Stainless steel
Fibers	12 pairs or 24 Fibers

5. AC Power Cable: AC power cable(s) shall be 3-conductor, no. 12 AWG minimum, and rated for 13A-125V and 1,625W. Master AC power, installation specification and requirements, are given in the NEC and herein.

6. General Purpose Analog RF:

- a. The coaxial cable shall be an RG-6/U type (or equal), minimum and shall be increased in size (i.e. RG-11/U, .500", .750", etc.) as required to meet system design. It may also be used for baseband signals as approved by the OEM.

b. Technical Characteristics:

Impedance	75 OHM, UNBAL
Center conductor	20 AWG, solid or stranded copper, or copper plated steel or aluminum
Dielectric	Cellular polyethylene
Shield coverage	95%, copper braid
Connector type	BNC or UHF
Attenuation	
Frequency (k or mHz)	Maximum dB/30.5M (100ft.)
10 kHz	0.20
100 kHz	0.22
1.0 kHz	0.25
4.5 mHz	0.85
10.0 mHz	1.40
100 mHz	5.00 //

7. Public Address and/or General Purpose Audio:

- a. The audio cable shall be two-conductor, STP cable with stranded conductors. The cable shall be able to handle the power used for the load impedance over the distance required, with not more than 5% power loss. This cable is to be provided in local PA areas only and is not to be used as a part of the telephone system.

b. Technical Characteristics:

Impedance	70.7VRMS audio signal
Wire size	20 AWG, minimum
Working shield	350 V
Color coding	Required, EIA audio industry standard
Connectors	As required
Bend radius	10X the cable outside diameter
Impedance	100 Ohms \pm 15%, BAL
Bandwidth	20 mHz, minimum
DC resistance	10.0 Ohms/100M (330 ft.), maximum
Shield coverage	
Overall Outside (if	100%

OEM specified)	
Individual Pairs (if OEM specified)	100%
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0 //

8. General Purpose Analog Video:

- a. The coaxial cable shall be an RG-59/U type (or equal), minimum.
It may also be used for baseband signals as approved by the OEM.
- b. Technical Characteristics:

Impedance	75 Ohm, UNBAL
Center conductor	20 AWG, SOLID OR STRANDED COPPER
Dielectric	Cellular polyethylene
Shield coverage	95%, copper braid
Connector type	BNC or UHF
Attenuation	
Frequency (k or mHz)	Maximum dB/30.5M (100ft.)
10 kHz	0.20
100 kHz	0.22
1.0 kHz	0.25
4.5 mHz	0.85
10.0 mHz	1.40
100 mHz	5.00 //

C. Outlet Connection Cables:

1. Telephone:

- a. The Contractor shall provide a connection cable for each TCO telephone jack in the System with 10% spares. The telephone

connection cable shall connect the telephone instrument to the TCO telephone jack. The Contractor shall not provide telephone instrument(s) or equipment.

b. Technical Characteristics:

Length	1.8M (6ft.), minimum
Cable	Voice Grade
Connector	RJ-11/45 compatible male on each end
Size	24 AWG, minimum
Color coding	Required, telephone industry standard

2. Data:

- a. The Contractor shall provide a connection cable for each TCO data jack in the system with 10% spares. The data connection cable shall connect a data instrument to the TCO data jack. The Contractor shall not provide data terminal(s)/equipment.

b. Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Data grade Category Six
Connector	RJ-45 male on each end
Color coding	Required, data industry standard
Size	24 AWG, minimum

3. Analog RF:

- a. The Contractor shall provide a connection cable for each TCO analog RF connector in the System with 10% spares. The analog RF connection cable shall connect an analog RF instrument to the TCO analog RF jack. The Contractor shall not provide analog RF equipment.

b. Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Flexible RG-6/U, minimum
Connector	"F" male on each end //

4. Analog Video:

- a. The Contractor shall provide a connection cable for each TCO analog video jack in the System with 10% spares. The analog video connection cable shall connect a analog video instrument to the TCO analog video jack. The Contractor shall not provide analog video instrument(s)/equipment.
- b. Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Flexible RG-59/U, minimum
Connector	BNC male on each end //

5. Analog Audio:

- a. The Contractor shall provide a connection cable for each TCO analog audio jack in the System with 10% spares. The analog audio connection cable shall connect a analog audio instrument to the TCO analog audio jack. The Contractor shall not provide analog audio instrument(s)/equipment.
- b. Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Flexible 22 AWG, STP, minimum
Connector	"XL" male on each end //

D. System Connectors:

1. Solderless (Forked Connector):

- a. The connector shall have a crimp-on coupling for quick connect/disconnect of wires or cables. The crimp-on connector shall be designed to fit the wire or cable furnished. The connector barrel shall be insulated and color-coded.
- b. Technical Characteristics:

Impedance	As required
Working Voltage	500 V

2. Multipin:

- a. The connector shall have a crimp-on coupling for quick connect/disconnect of wires or cables. The crimp-on connector shall be designed to fit the wire or cable furnished. The connector housing shall be fully enclosed and shielded. It shall be secured to the cable group by screw type compression sleeves.
- b. Technical Characteristics:

Impedance	As required
Working Voltage	500 V
Number of pins	As requires, usually 25 pairs minimum

3. Modular (RJ-45/11 and RJ-45): The connectors shall be commercial types for voice and high speed data transmission applications. he connector shall be compatible with telephone instruments, computer terminals, and other type devices requiring linking through the modular telecommunications outlet to the System. The connector shall be compatible with UTP and STP cables.

- a. Technical Characteristics:

Type	Number of Pins
RJ-11/45	Compatible with RJ45
RJ-45	Eight
Dielectric	Surge
Voltage	1,000V RMS, 60 Hz @ one minute, minimum
Current	2.2A RMS @ 30 Minutes or 7.0A RMS @ 5.0 seconds
Leakage	100 μ A, maximum
Connectability	
Initial contact resistance	20 mili-Ohms, maximum
Insulation displacement	10 mili-Ohms, maximum
Interface	Must interface with modular jacks from a variety of OEMs. RJ-11/45 plugs shall provide connection when used in RJ-45 jacks.
Durability	200 insertions/withdrawals, minimum

4. Fiber Optic: The connectors shall be commercial types for voice and high speed data transmission applications. The connector shall be compatible with telephone instruments, computer terminals, and other type devices requiring linking through the modular telecommunications outlet to the system. The connector shall be compatible with UTP and STP cables.

5. "BNC" Type:

- a. The BNC connector shall have a bayonet locking coupling for quick connect/disconnect of coaxial cable/termination's. It shall be a crimp-on (twist on are acceptable) connector designed to fit the coaxial cable furnished.
- b. Technical Characteristics:

Impedance	50 or 75 Ohms, UNBAL
Working Voltage	500 V //

6. "F" Type:

- a. The "F" connector shall have a screw type coupling for quick connect/disconnect of coaxial cable/termination's. It shall be a crimp-on connector designed to fit the coaxial cable furnished with integral 12.7 mm (½in.) ferrule.
- b. Technical Characteristics:

Impedance	75 Ohms, UNBAL
Working Voltage	500 V //

7. "XL" Type:

- a. The XL connector shall have three solder pins (screw types are acceptable) with a metal cover to firmly attach to the connector and cable protecting the internal connections. It shall be a coupling for quick connect/disconnect of audio cable/termination's. It shall be a connector designed to fit the coaxial cable furnished.
- b. Technical Characteristics:

Impedance	120 or 600 Ohms, BAL
Working Voltage	500 V //

E. Terminators:

1. Coaxial:

- a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on type that has low VSWR when installed and the proper impedance to terminate the required system unit or coaxial cable.
- b. Technical Characteristics:

Frequency	0-1 GHz
Power blocking	As required
Return loss	25 dB
Connectors	"F", "BNC", minimum
Impedance	50 or 75 Ohms, UNBAL

2. Audio:

- a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on audio spade lug, twin plug, XL types that has low VSWR when installed and the proper impedance to terminate the required system unit or coaxial cable.
- b. Technical Characteristics:

Frequency	20-20 kHz, minimum
Power blocking	As required
Return loss	15 dB
Connectors	"Audio spade lug", "1/4", "1/8", "XL" or "RCA"
Impedance	
Bal	100 Ohms, minimum
Unbal	75 Ohm, minimum

3. Fiber Optic:

- a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on type that has low VSWR when installed and the proper impedance to terminate the required system unit or fiber optic cable.
- b. Technical Characteristics:

Frequency	Lightwave
Power blocking	As required
Return loss	25 dB
Connectors	"ST", minimum
Construction	Stainless steel
Impedance	As required

F. Distribution Frames Existing Provided During Phase 1:

- Existing stand-alone (i.e., self supporting, free standing, Relay Type) IDF Racks shall be provided to interconnect the EPBX and computer room. The IDFs shall be modular and equipped with modular terminating mini blocks (i.e. Ericsson, 3M, etc.), and patch panels that are as small as possible and provide all the requirements of this specifications as described herein.
- All cable distribution closets and IDFs shall be wired in accordance with industry standards and shall employ "latest state-of-the-art" modular cross-connect devices. The MDF/telephone closet riser cable shall be sized to satisfy all voice requirements plus not less than 50% spare (growth) capacity in each telephone closet which includes a fiber optic backbone. The MDF/telephone closet riser cable shall be sized to satisfy all voice and data requirements plus not less than 50% spare (growth) capacity in each telephone closet which does not include a fiber optic backbone.
- The MDF and all intermediate distribution frames shall be connected to the EPBX system ground.
- Technical Characteristics:

IDC type unit	As described in Part 2
Contact wires	50 micron of Gold over Nickel
Contact pressure	100 Grams, MIN
110A Punch blocks	Acceptable alternate to IDC
Data	110A blocks as described in Part 2
Fiber optic	Patch panel as described in Part 2
Analog Video	Patch panel as described in Part 2

- All IDF Racks shall be provided with UPS Battery Backups.

A. UPS Characteristics:

Smart Slot	CD with Software, DB-9 RS-232, USB
Input	120V
Output	120V
Output Power Capacity	1980 Watts / 2200 VA
Max. Configurable Power	1980 Watts / 2200 VA
Efficiency at full load	95%
Output Frequency	57-60 Hz

2.3 TELECOMMUNICATIONS CLOSET REQUIREMENTS

Refer to VA Handbook H-088C3, Telephone System Requirements, for specific TC guidelines for size, power input, security, and backboard mounting requirements. It is the Contractors responsibility to ensure TC compliance with the System Requirements.

2.4 ENVIRONMENTAL REQUIREMENTS

Technical submittals shall identify the environmental specifications for housing the system. These environmental specifications shall identify the requirements for initial and expanded system configurations for:

- A. Floor loading for batteries and cabinets.
- B. Minimum floor space and ceiling heights.
- C. Minimum size of doors for equipment passage.
- D. Power requirements: The bidders shall provide the specific voltage, amperage, phases, and quantities of circuits required.
- E. Air conditioning, heating, and humidity requirements. The bidder shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
- F. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).
- G. Proposed floor plan based on the expanded system configuration of the bidder's proposed EPBX for this Facility.
- H. Conduit size requirement (between equipment room and console room).

2.5 INSTALLATION KIT

The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties,

solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the 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:

A. System Grounding:

1. The grounding kit shall include all cable and installation hardware required. All radio equipment shall be connected to earth ground via internal building wiring, according to the NEC.
2. This includes, but is not limited to:
 - a. Coaxial Cable Shields.
 - b. Control Cable Shields.
 - c. Data Cable Shields.
 - d. Equipment Racks.
 - e. Equipment Cabinets.
 - f. Conduits.
 - g. Duct.
 - h. Cable Trays.
 - i. Power Panels.
 - j. Connector Panels.
 - k. Grounding Blocks.

B. 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.

C. 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.

D. 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.

- E. 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.
- F. 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.
- 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 completely and correctly provide the system documentation as required by this document and explained herein.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Product Delivery, Storage and Handling:
 - 1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment catalog numbers, model and serial identification numbers. The RE may inventory the cable, patch panels, and related equipment.
 - 2. Storage and Handling: Store and protect equipment in a manner, which will preclude damage as directed by the RE.
- B. System Installation:
 - 1. After the contract's been awarded, and within the time period specified in the contract, the Contractor shall deliver the total system in a manner that fully complies with the requirements of this specification. The Contractor shall make no substitutions or changes in the System without written approval from the RE and PM.
 - 2. The Contractor shall install all equipment and systems in a manner that complies with accepted industry standards of good practice, OEM instructions, the requirements of this specification, and in a manner which does not constitute a safety hazard. The Contractor shall insure that all installation personnel understands and complies with all the requirements of this specification.
 - 3. The Contractor shall install suitable filters, traps, directional couplers, splitters, TC's, and pads for minimizing interference and for balancing the System. Items used for balancing and minimizing

interference shall be able to pass telephone and data, and lightwave and analog signals in the frequency bands selected, in the direction specified, with low loss, and high isolation, and with minimal delay of specified frequencies and signals. The Contractor shall provide all equipment necessary to meet the requirements of Paragraph 2.1.C and the System performance standards.

4. All passive equipment shall be connected according to the OEM's specifications to insure future correct termination, isolation, impedance match, and signal level balance at each telephone/data outlet.
5. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
6. All lines shall be terminated in a suitable manner to facilitate future expansion of the System. There shall be a minimum of one spare 25 pair cable at each distribution point on each floor.
7. All vertical and horizontal copper and fiber optic , and coaxial cables shall be terminated so any future changes only requires modifications of the existing EPBX or signal closet equipment only.
8. Terminating resistors or devices shall be used to terminate all unused branches, outlets, equipment ports of the System, and shall be devices designed for the purpose of terminating fiber optic or twisted pair and coaxial and lightwave cables carrying telephone and data and analog signals in telephone and data and analog video, and lightwave systems.
9. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two keys.
10. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks with two keys.

C. Conduit and Signal Ducts:

1. Conduit:

- a. The Contractor shall employ the latest installation practices and materials. The Contractor shall provide conduit, junction boxes, connectors, sleeves, weatherheads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc., shall be sleeved and sealed. The minimum conduit size shall be 19 mm (3/4 in.).

- b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow telephone cables and data cables to be installed open supported to building structure per requirements of the NEC.) 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 "innerduct" flexible cable protective systems is specifically authorized to be provided for use in the System, it's installation guidelines and standards shall be as the specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
 - e. Conduit (including GFE) fill shall not exceed 40%. Each conduit end shall be equipped with a protective insulator or sleeve to cover the conduit end, connection nut or clamp, to protect the wire or cable during installation and remaining in the conduit. Electrical power conduit shall be installed in accordance with the NEC. AC power conduit shall be run separate from signal conduit.
 - f. 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.
 - g. Ensure that Critical Care Nurse Call, Fire Alarm and PA Systems (as identified by NEC Section 517) are completely separated and protected from all other systems.
2. Signal Duct, Cable Duct, or Cable Tray:
- a. The Contractor shall use existing 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. Distribution System Signal Wires and Cables:

- 1. Wires and cables shall be provided in the same manner and use like construction practices as Fire Protective and other Emergency Systems that are identified and outlined in NFPA 101, Life Safety Code, Chapters 7, 12, and/or 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions. The wires and cables shall be able to withstand adverse environmental conditions in their respective location without deterioration. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
 - a. Each wire and cable shall terminate on an item of equipment by direct connection. Spare or unused wire and cable shall be provided with appropriate connectors (female types) that are installed in appropriate punch blocks, barrier strips, patch, or bulkhead connector panels.
 - b. Fiber optic cables that are spare, unused or dark shall be provided with Industry Standard "ST" type female connectors installed in appropriate break out, patch, or bulkhead connector panels provided in enclosure(s) and shall be protected from the environment.
 - c. Coaxial cables that are spare, unused or dark shall be provided with the cable OEM specified type female connectors installed in appropriate break out, patch, or bulkhead connector panels provided in enclosure(s) and shall be protected from the environment.
 - d. All cable junctions and taps shall be accessible. Provide an 8" X 8" X 4" (minimum) junction box attached to the cable duct or raceway for installation of distribution system passive equipment. Ensure all equipment and tap junctions are accessible.
- 2. Routing and Interconnection:

- a. Wires or cables between consoles, cabinets, racks and other equipment shall be in an approved conduit, signal duct, cable duct, or cable tray that is secured to building structure.
- b. Wires and cables shall be insulated to prevent contact with signal or current carrying conductors. Wires or cables used in assembling consoles, panels, equipment cabinets and racks shall be formed into harnesses that are bundled and tied. Harnessed wires or cables shall be combed straight, formed and dressed in either a vertical or horizontal relationship to equipment, controls, components or terminations.
- c. Harnesses with intertwined members are not acceptable. Each wire or cable that breaks out from a harness for connection or termination shall have been tied off at that harness or bundle point, and be provided with a neatly formed service loop.
- d. Wires and cables shall be grouped according to service (i.e.: AC, grounds, signal, DC, control, etc.). DC, control and signal cables may be included with any group. Wires and cables shall be neatly formed and shall not change position in the group throughout the conduit run. Wires and cables in approved signal duct, conduit, cable ducts, or cable trays shall be neatly formed, bundled, tied off in 600 mm to 900 mm (24 in. to 36 in.) lengths and shall not change position in the group throughout the run. Concealed splices are not allowed.
- e. Separate, organize, bundle, and route wires or cables to restrict EMI, channel crosstalk, or feedback oscillation inside any enclosure. Looking at any enclosure from the rear (wall mounted enclosures, junction, pull or interface boxes from the front), locate AC power, DC and speaker wires or cables on the left; coaxial, control, microphone and line level audio and data wires or cables, on the right. This installation shall be accomplished with ties and/or fasteners that will not damage or distort the wires or cables. Limit spacing between tied off points to a maximum of 150 mm (6 inches).
- f. Do not pull wire or cable through any box, fitting or enclosure where change of cable tray or signal or cable duct alignment or direction occurs. Ensure the proper bend radius is maintained for each wire or cable as specified by its OEM.

- g. Employ temporary guides, sheaves, rollers, and other necessary items to protect the wire or cable from excess tension or damage from bending during installation. Abrasion to wire or cable jackets is not acceptable and will not be allowed. Replace all cables whose jacket has been abraded. The discovery of any abraded and/or damaged cables during the proof of performance test shall be grounds for declaring the entire system unacceptable and the termination of the proof of performance test. Completely cover edges of wire or cable passing through holes in chassis, cabinets or racks, enclosures, pull or junction boxes, conduit, etc., with plastic or nylon grommeting.
- h. Cable runs shall be splice free between termination to termination or conduit junction and interface boxes and equipment locations.
- i. Cables shall be installed and fastened without causing sharp bends or rubbing of the cables against sharp edges. Cables shall be fastened with hardware that will not damage or distort them.
- j. Cables shall be labeled with permanent markers at the terminals of the electronic and passive equipment and at each junction point in the System. The lettering on the cables shall correspond with the lettering on the record diagrams.
- k. Completely test all of the cables after installation and replace any defective cables.
- l. Wires or cables that are installed outside of buildings shall be in conduit, secured to solid building structures. If specifically approved, on a case by case basis, 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.
- m. Wires or cables installed outside of conduit, cable trays, wireways, cable duct, etc.
 - 1) Where demonstrated on the plan and as described herein, wires or cables are 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.

- 2) Wires and cables shall be hidden, protected, fastened and tied at 600 mm (24 in.) intervals, maximum, as described herein to building structure.
- 3) Closer wire or cable fastening intervals may be required to prevents sagging, maintain clearance above suspended ceilings, remove unsightly wiring and cabling from view and discourage tampering and vandalism. Wire or cable runs, not provided in conduit, that penetrate outside building walls, supporting walls, and two hour fire barriers shall be sleeved and sealed with an approved fire retardant sealant.
- 4) Wire or cable runs to system components installed in walls (i.e.: volume attenuators, circuit controllers, signal, or data outlets, 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. Outlet Boxes, Back Boxes, and Faceplates:

1. Outlet Boxes: Signal, power, interface, connection, distribution, and junction boxes shall be provided as required by the system design, on-site inspection, and review of the contract drawings.
2. Back Boxes: Back boxes shall be provided as directed by the OEM as required by the approved system design, on-site inspection, and review of the contract drawings.
3. Face Plates (or Cover Plates): Faceplates shall be of a standard type, stainless steel, anodized aluminum or UL approved cyclolac plastic construction and provided by the Contractor for each identified system outlet location. Connectors and jacks appearing on the faceplate shall be clearly and permanently marked.

F. Connectors: Circuits, transmission lines, and signal extensions shall have continuity, correct connection and polarity. A uniform polarity shall be maintained between all points in the system.

1. Wires:

- a. Wire ends shall be neatly formed and where insulation has been cut, heat shrink tubing shall be employed to secure the insulation on each wire. Tape of any type is not acceptable.
- b. Audio spade lugs shall be installed on each wire (including spare or unused) end and connect to screw terminals of appropriate size

barrier strips. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current. Punch blocks are approved for signal, not AC wires. Wire Nut or "Scotch Lock" connectors are not acceptable for signal wire installation.

2. Cables: Each connector shall be designed for the specific size cable being used and installed with the OEM's approved installation tool. Typical system cable connectors include; but, are not limited to: Audio spade lug, punch block, wirewrap, etc.

3. Line or Microphone Audio: Each connector shall be installed according to the cable or connector OEM's instructions and use the OEM's approved installation tool. Install the connector's to provide and maintain the following audio signal polarity:

- a. XLR type connectors Signal or positive conductor is pin 3; common or neutral conductor is pin 2; ground conductor is pin 1.
- b. Two and 3 conductor 1/4" Signal or positive conductor is tip; neutral or 1/8" phono plugs conductor is ring and ground or shield and jacks conductor is sleeve.
- c. RCA Phono Plugs the Signal or positive conductor is tip; and Jacks neutral or shield conductor is sleeve.

4. Speaker Line Audio:

- a. Each connector shall be installed according to the cable, transformer or speaker OEM instructions and using the OEM's approved installation tool. The Contractor shall ensure each speaker is properly phased and connected in the same manner throughout the System using two conductor type wires.
- b. One of the conductors shall be color coded to aid in establishing speaker signal polarity. Each speaker line shall be permanently soldered or audio spade lug connected to each appropriate speaker or line matching transformer connection terminal. Speaker line connection to each audio amplifier shall use audio spade lugs, as described herein.

G. AC Power: AC power wiring shall be run separately from signal cable.

H. Grounding:

1. General: The Contractor shall ground all Contractor Installed Equipment and identified Government Furnished Equipment to eliminate all shock hazards and to minimize, to the maximum extent possible,

- all ground loops, common mode returns, noise pickup, crosstalk, etc. The total ground resistance shall be 0.1 Ohm or less.
- a. The Contractor shall install lightning arrestors and grounding in accordance with the NFPA and this specification.
 - b. Gas protection devices shall be provided on all circuits and cable pairs serving building distribution frames located in buildings other than the building in which it is located or in any area served by an unprotected distribution system (manhole, aerial, etc.). The Contractor shall install the gas protection devices at the nearest point of entrance in buildings where protection is required and on the same circuits on the MDF in the telephone switch room.
 - c. Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, subcarrier or audio reference ground.
 - d. The use of conduit, signal duct or cable trays as system or electrical ground is not acceptable and will not be permitted. These items may be used only for the dissipation of internally generated static charges (not to be confused with externally generated lightning) that may applied or generated outside the mechanical and/or physical confines of the System to earth ground. The discovery of improper system grounding shall be grounds to declare the System unacceptable and the termination of all system acceptance testing.
2. Cabinet Buss: A common ground buss of at least #10 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground. Provide a separate isolated ground connection from each equipment cabinet ground buss to the system ground. Do not tie equipment ground busses together.
 3. Equipment: Equipment shall be bonded to the cabinet bus with copper braid equivalent to at least #12 AWG. Self grounding equipment enclosures, racks or cabinets, that provide OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternates.
 4. Cable Shields: Cable shields shall be bonded to the cabinet ground buss with #12 AWG minimum stranded copper wire at only one end of the cable run. Cable shields shall be insulated from each other, faceplates, equipment racks, consoles, enclosures or cabinets;

except, at the system common ground point. Coaxial and audio cables, shall have one ground connection at the source; in all cases, cable shield ground connections shall be kept to a minimum.

- I. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for voice and data circuits shall be stenciled using laser printers thermal ink transfer process. Handwritten labels are not acceptable.
1. Cable and Wires (Hereinafter referred to as "Cable"): Cables shall be labeled at both ends in accordance with ANSI/EIA/TIA-606-A. Labels shall be permanent in contrasting colors. Cables shall be identified according to the System "Record Wiring Diagrams".
2. Equipment: System equipment shall be permanently labeled with contrasting plastic laminate or bakelite material. System equipment shall be labeled on the face of the unit corresponding to its source.
3. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying it as the System. In addition, each enclosure shall be labeled according to this standard.
4. Termination Hardware: The Contractor shall label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with ANSI/EIA/TIA-606-A and the "Record Wiring Diagrams".

3.2 TESTS

A. Interim Inspection:

1. This inspection shall verify that the equipment provided adheres to the installation requirements of this document. The interim inspection will be conducted by a factory-certified representative and witnessed by a Government Representative. Each item of installed equipment shall be checked to insure appropriate UL certification markings. This inspection shall verify cabling terminations in telecommunications rooms and at workstations adhere to color code for T568A pin assignments and cabling connections are in compliance with ANSI/EIA/TIA standards. Visually confirm Category 6 marking of outlets, faceplates, outlet/connectors and patch cords.
2. Perform fiber optical field inspection tests via attenuation measurements on factory reels and provide results along with

- manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
3. The Contractor shall notify the RE, in writing, of the estimated date the Contractor expects to be ready for the interim inspection, at least 20 working days before the requested inspection date.
 4. Results of the interim inspection shall be provided to the RE and PM. If major or multiple deficiencies are discovered, a second interim inspection may be required before permitting the Contractor to continue with the system installation.
 5. The RE and/or the PM shall determine if an additional inspection is required, or if the Contractor will be allowed to proceed with the installation. In either case, re-inspection of the deficiencies noted during the interim inspection(s), will be part of the proof of performance test. The interim inspection shall not affect the Systems' completion date. The Contracting Officer shall ensure all test documents will become a part of the Systems record documentation.

B. Pretesting:

1. Upon completing the installation of the System, the Contractor shall align and balance the system. The Contractor shall pretest the entire system.
2. Pretesting Procedure:
 - a. During the system pretest, the Contractor shall verify (utilizing the approved spectrum analyzer and test equipment) that the System is fully operational and meets all the system performance requirements of this standard.
 - b. The Contractor shall pretest and verify that all System functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. The Contractor shall measure and record the aural carrier levels of each system telephone and data channel, at each of the following points in the system:
 - 1) Local Telephone Company Interfaces or Inputs.
 - 2) EPBX interfaces or inputs and outputs.
 - 3) MDF interfaces or inputs and outputs.
 - 4) EPBX output S/NR for each telephone and data channel.

- 5) Signal Level at each interface point to the distribution system, the last outlet on each trunk line plus all outlets installed as part of this contract.
3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.
- C. Acceptance Test: After the System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 30 days written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of a Government Representative and an OEM certified representative. The System shall be tested utilizing the approved test equipment to certify proof of performance and Life Safety compliance. The test shall verify that the total System meets the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
- D. Verification Tests:
 1. Test the UTP STP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has an overall shield. Test the operation of shorting bars in connection blocks. Test cables after termination and prior to cross-connection.
 2. Multimode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with ANSI/EIA/TIA-568-B.3 and ANSI/EIA/TIA-526-14A using Method A, Optical Power Meter and Light Source and/or Method B, OTDR. Perform verification acceptance test.
- E. Performance Testing:
 1. Perform Category 6 tests in accordance with ANSI/EIA/TIA-568-B.1 and ANSI/EIA/TIA-568-B.2. Test shall include the following: wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.
 2. Fiber Optic Links: Perform end-to-end fiber optic cable link tests in accordance with ANSI/EIA/TIA-568-B.3.
- F. Total System Acceptance Test: The Contractor shall perform verification tests for UTP or STP copper cabling system(s) and the multimode

system(s) after the complete telecommunication distribution system and workstation outlet are installed.

1. Voice Testing: Connect to the network interface device at the demarcation point. Go off-hook and receive dial tone from the LEC. If a test number is available, place and receive a local, long distance, and FTS telephone call.
2. Data Testing: Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network is achieved.

3.3 TRAINING

- A. Furnish the services of a factory-trained engineer or technician for a total of two four hour classes to instruct designated Facility IRM personnel. Instruction shall include cross connection, corrective, and preventive maintenance of the System and equipment.
- B. Before the System can be accepted by the VA, this training must be accomplished. Training will be scheduled at the convenience of the Facilities Contracting Officer and Chief of Engineering Service.

3.4 GUARANTEE PERIOD OF SERVICE

- A. Contractor's Responsibilities:
 1. The Contractor shall guarantee that all installed material and equipment will be free from defects, workmanship, and will remain so for a period of one year from date of final acceptance of the System by the VA. The Contractor shall provide OEM's equipment warranty documents, to the RE (or Facility Contracting Officer if the Facility has taken possession of the building(s)), that certifies each item of equipment installed conforms to OEM published specifications.
 2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. The Contractor and OEM shall provide this contact capability at no additional cost to the VA.
 3. All Contractor installation, maintenance, and supervisor personnel shall be fully qualified by the OEM and 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 one year guarantee period:

a. Response Time:

- 1) The RE (or facility Contracting Officer if the facility has taken possession of the building[s]) are the Contractor's reporting and contact officials for the System trouble calls, during the guarantee period.
- 2) A standard workweek is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal Holidays.
- 3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
 - a) A routine trouble call within one working days of its report. A routine trouble is considered a trouble which causes a system outlet, station, or patch cord to be inoperable.
 - b) An emergency trouble call within 6 hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point to be inoperable at anytime. Additionally, the loss of a minimum of 50 station or system lines shall be deemed as this type of a trouble call.
- 4) The Contractor shall respond on-site to a catastrophic trouble call within 4 hours of its report. A catastrophic trouble call is considered total system failure.
 - a) If a system failure cannot be corrected within four hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate system CSS or TCO equipment, or cables. The alternate equipment and/or cables shall be operational within four hours after the four hour trouble shooting time.
 - b) Routine or emergency trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as a catastrophic trouble call if so determined by the RE or Facility Director. The COTR or Facility Contracting Officer shall notify the Contractor of this type of trouble call at the direction of the Facilities Director.

b. Required on-site visits during the one year guarantee period

- 1) The Contractor shall visit, on-site, for a minimum of eight hours, once every 12 weeks, during the guarantee period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this SPEC.
 - a) The Contractor shall arrange all Facility visits with the RE or Facility Contracting Officer prior to performing the required maintenance visits.
 - b) The Contractor in accordance with the OEM's recommended practice and service intervals shall perform preventive maintenance during a non-busy time agreed to by the COTR or Facility Contracting Officer and the Contractor.
 - c) The preventive maintenance schedule, functions and reports shall be provided to and approved by the RE or Facility Contracting Officer.
- 2) The Contractor shall provide the COTR 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 Total System Acceptance Test. The following reports are the minimum required:
 - a) Monthly Report: The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to RE or Facilities Contracting Officer by the fifth working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and Systems for preventive and predictive maintenance
 - b) Contractor Log: The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the System. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.

- 3) The COTR or Facility Contracting Officer shall provide the Facility Engineering Officer, two (2) copies of actual reports for evaluation.
 - a) The RE or Facility Contracting Officer shall ensure copies of these reports are entered into the System's official acquisition documents.
 - b) The Facilities Chief Engineer shall ensure copies of these reports are entered into the System's official technical as-installed documents.
- B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use, accidents, other vendor, contractor, owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the 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 findings concerning any Contractor's responsibility.

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SECTION 27 31 31

VOICE, DIGITAL AND ANALOG TELECOMMUNICATION DISTRIBUTION CABLE EQUIPMENT AND SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies the furnishing, installing, certification, testing, and guaranty of a complete and operating Voice and Digital Cable Distribution System (here-in-after referred to as "*the System*"), and associated equipment and hardware to be installed in the VA Medical Center, Out Patient Clinic, Nursing Home Care Unit, Domiciliary, or Other premises monitored by the Veterans Affairs here-in-after referred to as "*the Facility*". The System shall include, but not be limited to: equipment cabinets, interface enclosures, and relay racks; necessary combiners, traps, and filters; and necessary passive devices such as: splitters, couplers, cable "patch", "punch down", and cross-connector blocks or devices, voice and data distribution sub-systems, and associated hardware as shown on the design drawings. The System shall additionally include, but not be limited to: telecommunication closets (TC); telecommunications outlets (TCO); copper and fiber optic, and analog radio frequency (RF) systems coaxial distribution cables, connectors, "patch" cables, and/or "break out" devices.
- B. The System shall be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.
- C. The term "provide", as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.
- D. The Voice and Digital and Analog Telecommunication Distribution Cable Equipment and System provides the media which voice and data information travels over and connects to the Telephone System which is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Therefore, since the System connects to or extends the telephone system, the System's installation and operation shall adhere to all appropriate National, Government, and/or Local Life Safety and/or Support Codes, which ever are the more stringent for this Facility. At a minimum , the System shall be installed according to NFPA, Section 70, National Electrical Code (NEC), Article 517 and Chapter 7; NFPA, Section 99, Health Care

Facilities, Chapter 3-4; NFPA, Section 101, Life Safety Code, Chapters 7, 12, and/or 13; Joint Commission on Accreditation of Health Care Organization (JCAHCO), Manual for Health Care Facilities, all necessary Life Safety and/or Support guidelines; this specification; and the original equipment manufacturer's (OEM) suggested installation design, recommendations, and instructions. The OEM and Contractor shall ensure that all management, sales, engineering, and installation personnel have read and understand the requirements of this specification before the System is designed, engineered, delivered, and provided.

E. The VA Project Manager (PM) and/or if delegated, Resident Engineer (RE) are the approving authorities for all contractual and mechanical changes to the System. The Contractor is cautioned to obtain in writing, all approvals for system changes relating to the published contract specifications and drawings, from the PM and/or the RE before proceeding with the change.

F. System Performance:

1. At a minimum, the System shall be able to support the following voice and data and analog RF operations for Category 6 Certified Telecommunication Service:

a. Provide the following interchange (or interface) capabilities:

- 1) Basic Rate (BRI).
- 2) Primary Rate (PRI).

b. ISDN measured at the TE1 Device:

1) Narrow Band BRI:

- a) B Channel: 64 kilo-Bits per second (kBps), minimum.
- b) D Channel: 16 kBps, minimum.
- c) H Channel: 384 kBps, minimum.

2) Narrow Band PRI:

- a) B Channel: 64 kBps, minimum.
- b) D Channel: 64 kBps, minimum.
- c) H Channel: 1,920 kBps, minimum.

3) Wide (or Broad) Band: All channels: 140 mega(m)-Bps, minimum, capable to 565 mBps at "T" reference.

c. ATM operation and interface: ATM 155 mBps measured at the Existing Switch.

d. Frame Relay: All stated compliance's measured at ISDN Switch.

e. Integrated Data Communications Utility (IDCU) operation and interface: Insure Compliance with existing interfaces.

- f. Government Open Systems Interconnection Profile (GOSSIP)
compliant: Measured at NIST for Compliance with FIPS 146-2.
 - g. Fiberoptic Distributed Data Interface (FDDI): A minimum 100 mBps
to a maximum of 1.8 giga(g)-Bps data bit stream speed measured
Between FDDI Boards. (shall be Synchronous Optical Network
[SONET] compliant).
 - h. System Sensitivity: Satisfactory service shall be provided for at
least 3,000 feet for all voice and data and analog RF locations.
2. At a minimum the System shall support the following operating
parameters:
- a. EPBX connection:
 - 1) System speed: 1.0 gBps per second, minimum.
 - 2) Impedance: 600 Ohms.
 - 3) Cross Modulation: -60 deci-Bel (dB).
 - 4) Hum Modulation: -55 dB.
 - 5) System data error: 10 to the -10 Bps, minimum.
 - 6) Loss: Measured at the frame output with reference Zero (0)
decibel measured (dBm) at 1,000 Hertz (Hz) applied to the
frame input.
 - a) Trunk to station: 1.5 dB, maximum.
 - b) Station to station: 3.0 dB, maximum.
 - c) Internal switch crosstalk: -60 dB when a signal of ± 10
decibel measured (dBm), 500-2,500 Hz range is applied to
the primary path.
 - d) Idle channel noise: 25 dBm "C" or 3.0 dBm "O" above
reference (terminated) ground noise, whichever is greater.
 - e) Traffic Grade of Service for Voice and Data:
 - (1) A minimum grade of service of P-01 with an average
traffic load of 7.0 CCS per station per hour and a traffic
overload in the data circuits will not interfere with, or
degrade, the voice service.
 - (2) Average CCS per voice station: The average CCS capacity
per voice station shall be maintained at 7.0 CCS when the
EPBX is expanded up to the projected maximum growth as
stated herein.
 - b. Telecommunications Outlet (TCO):
 - 1) Voice:
 - a) Isolation (outlet-outlet): 24 dB.

- b) Impedance: 600 Ohms, balanced (BAL).
 - c) Signal Level: 0 deciBel per mili-Volt (dBmV) \pm 0.1 dBmV.
 - d) System speed: 100 mBps, minimum.
 - e) System data error: 10 to the -6 Bps, minimum.
- 2) Data:
- a) Isolation (outlet-outlet): 24 dB.
 - b) Impedance: 600 Ohms, BAL.
 - c) Signal Level: 0 dBmV \pm 0.1 dBmV.
 - d) System speed: 120 mBps, minimum.
 - e) System data error: 10 to the -8 Bps, minimum.
- 3) Fiber optic:
- a) Isolation (outlet-outlet): 36 dB.
 - b) Signal Level: 0 dBmV \pm 0.1 dBmV.
 - c) System speed: 540 mBps, minimum.
 - d) System data error: 10 to the -6 bps, minimum.
- 4) Analog RF Service:
- a) Broadcast or "off air" RF (or television) analog service is considered to be at RF (below 900 mHz in frequency bandwidth). Usually a RF television circuits require a single coaxial cable plant from the headend to each TC location.
 - b) Isolation (outlet-outlet): 14 dB.
 - c) Impedance: 75 Ohms, Unbalanced (UNBAL).
 - d) Signal Level: 10 dBmV \pm 5.0 dBmV.
 - e) Bandwidth: 6.0 mHz per channel, fully loaded.
- 5) Closed Circuit Analog Video Service: Analog video service is considered to be at baseband (below 100 mHz in frequency bandwidth). An analog video circuit requires a separate analog video from the audio connector. The following minimum operating parameters shall be capable over each installed analog video circuit:

Impedance	75 Ohm, unbalanced
Output Level	1.0 V peak to peak (P-P), for 87.5% depth of Modulation (Mod)
Diff Gain	\pm 1 dB at 87.5% Mod
Diff Phase	\pm 1.5 at 87.5% Mod
Signal to Noise (S/N) ratio	44 dB, minimum
Hum Modulation	-55 dB

Return Loss	-14 dB (or 1.5 Voltage Standing Wave Ratio [VSWR]), maximum
Isolation (outlet-outlet)	24 DB, MINIMUM
Bandwidth	6.0 mHz per channel, fully loaded, minimum

- 6) Closed Circuit Analog Audio Service: Analog audio service is considered to be at baseband (below 10 mHz in frequency bandwidth). Usually an analog audio circuit requires separate audio connectors and video connectors even though both are considered baseband signals. However, since each TCO has multiple 600 (or 120) Ohm BAL line pairs, the analog audio circuit may be designated to one of the provided pairs of UTP or STP for each TCO and as shown on the drawings, in lieu of providing a separate baseband audio run to the TCO. The following minimum operating parameters shall be capable over each installed analog audio circuit:

Impedance	600 Ohm, BAL
Input Level	59 mV Root Mean Squared (RMS), minimum
Output Level	0 dBm
S/N ratio	55 dB, minimum
Hum Modulation	-50 dB, minimum
Return Loss	-14 dB (or 1.5 VSWR), maximum
Isolation (outlet-outlet)	24 DB, MINIMUM
Frequency Bandwidth	100 Hz - 10K Hz, minimum //

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Section 27 10 00, STRUCTURED CABLING.
- E. Section 26 27 26, WIRING DEVICES.
- F. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- G. Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- H. Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.

- I. H-088C3: VA HANDBOOK DESIGN FOR TELEPHONE SYSTEMS
- K. Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT
 - Extension.
- L. Section 27 51 16, PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS.
- M. Section 01 00 00, GENERAL REQUIREMENTS

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. Except for a specific date given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date the system's submittal is technically approved by VA, shall be enforced.
- B. Joint Commission on Accreditation of Health Care Organization (JCAHO): Comprehensive Accreditation Manual for Hospitals - Volumes One and Two.
- C. National and/or Government Life Safety Code(s): The more stringent of each listed code.
- D. National Fire Protection Association (NFPA):

No. 70	National Electrical Code (NEC)
No. 75	Protection of Electronic Computer/Data Processing Systems
No. 77	Recommended Practice on Static Electricity
No. 99	Standard for Health Care Facilities
No. 101	Life Safety Code
No. 1221	Emergency Services Communication Systems

- E. Underwriter's Laboratories, Inc. (UL):

65	Wired Cabinets
96	Lightning Protection Components
96A	Installation Requirements for Lightning Protection Systems
467	Grounding and Bonding Equipment
497/497A/497B	Protectors for Paired Conductors/ Communications Circuits/Data Communications and Fire Alarm Circuits
884	Underfloor Raceways and Fittings

F. ANSI/EIA/TIA PUBLICATIONS:

568B	Commercial Building Telecommunications
569B	COMMERCIAL BUILDING STANDARD FOR TELECOMMUNICATIONS PATHWAYS AND SPACES
598C	Optical Fiber Cable Color Coding
606A	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
607A	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings
758	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings

- G. Lucent Technologies: Document 900-200-318 "Outside Plant Engineering Handbook".
- H. International Telecommunication Union - Telecommunication Standardization Sector (ITU-T).
- I. Federal Information Processing Standards (FIPS) Publications.
- J. Federal Communications Commission (FCC) Publication: Standards for telephone equipment and systems.
- K. United States Air Force: Technical Order 33K-1-100 - Test Measurement and Diagnostic Equipment (TMDE) Interval Reference Guide.

1.4 QUALITY ASSURANCE

- A. The authorized representative of the OEM, shall be responsible for the design, satisfactory total operation of the System, and its certification.
- B. The OEM shall meet the minimum requirements identified in Paragraph 2.1.A. Additionally, the Contractor shall have had experience with three or more installations of systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identification of these installations shall be provided as a part of the submittal as identified in Paragraph 1.5.
- C. The System Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The System Contractor shall be authorized by the OEM to certify and warranty the installed equipment. In addition, the OEM and System Contractor shall accept complete responsibility for the design, installation, certification, operation,

and physical support for the System. This documentation, along with the System Contractor and OEM certification must be provided in writing as part of the Contractor's Technical Submittal.

- D. All equipment, cabling, terminating hardware, TCOs, and patch cords shall be sourced from the certifying OEM or at the OEM's direction, and support the System design, the OEM's quality control and validity of the OEM's warranty.
- E. The Contractor's Telecommunications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the RE before being allowed to commence work on the System.

1.5 SUBMITTALS

- A. Provide submittals in accordance with Specification SECTION 01340, SAMPLES AND SHOP DRAWINGS. The RE shall retain one copy for review and approval.
 - 1. If the submittal is approved the RE shall retain one copy for Official Records and return three (3) copies to the Contractor.
 - 2. If the submittal is disapproved, three (3) copies will be returned to the Contractor with a written explanation attached that indicates the areas the submittal deviated from the System specifications. The RE shall retain one copy for Official Records.
- B. Environmental Requirements: Technical submittals shall confirm the environmental specifications for physical TC areas occupied by the System. These environmental specifications shall identify the requirements for initial and expanded system configurations for:
 - 1. Floor loading for batteries and cabinets.
 - 2. Minimum floor space and ceiling heights.
 - 3. Minimum size of doors for equipment passage.
 - 4. Power requirements: The Contractor shall provide the specific voltage, amperage, phases, and quantities of circuits required.
 - 5. Air conditioning, heating, and humidity requirements. The Contractor shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
 - 6. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).

7. Proposed floor plan, based on the expanded system configuration of the bidder's proposed EPBX for this FACILITY.
 8. Conduit size requirement (between main TC, computer, and console rooms).
 9. Main backbone, trunk line, riser, and horizontal cable pathways, cable duct, and conduit requirements between each MTC, TC, and TCO.
- C. Documents: The submittal shall be separated into sections for each subsystem and shall contain the following:
1. Title page to include:
 - a. VA Medical Center.
 - b. Contractor's name, address, and telephone (including FAX) numbers.
 - c. Date of Submittal.
 - d. VA Project No.
 2. List containing a minimum of three locations of installations of similar size and complexity as identified herein. These locations shall contain the following:
 - a. Installation Location and Name.
 - b. Owner's or User's name, address, and telephone (including FAX) numbers.
 - c. Date of Project Start and Date of Final Acceptance by Owner.
 - d. System Project Number.
 - e. Brief (three paragraphs minimum) description of each system's function, operation, and installation.
 3. Narrative Description of the system.
 4. A List of the equipment 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 and edit between the // - //. Delete equipment items that are not required add additional items required, and renumber section as per system design. The following is the minimum equipment required by the system:

QUANTITY	UNIT
//As required//	Cabinet Assembly(s)
//As required//	Distribution Backboard
//As required//	Distribution/Interface Cabinet
//As required//	Equipment (Radio Relay) Rack

//As required//	Cross Connection (CCS) Systems
//As required//	Audio Alarm Panel
//As required//	TROUBLE ANNUNCIATOR PANEL
//As required//	Lightning Protection System
//As required//	Wire Management System/Equipment
//As required//	Telecommunications Outlets (TCO)
//As Required//	Distribution Cables
//As required//	TCO Connection Cables
//As required//	System Connectors
//As required//	Terminators
//As required//	Distribution Frames
//As required//	Telecommunications Closets (TC)
//As required//	Environmental Requirements
1 ea.	Installation Kit
//As-required//	Separate List Containing Each Equipment Spare(s)

5. Pictorial layouts of each MTC, IMTC, and RTCs; MCCS, IMCCS, VCCS, and HCCS termination cabinet(s), each distribution cabinet layout drawing, and TCO as each is expected to be installed and configured.
 6. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
 7. Engineering drawings of the System, showing calculated signal levels at the EPBX output, each input and output distribution point, proposed TCO values, and signal level at each TCO multipin, fiberoptic, and coaxial cable jack.
 8. List of test equipment as per paragraph 1.5.D. below.
 9. Letter certifying that the Contractor understands the requirements of the SAMPLES Paragraph 1.5.E.
 10. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning acceptance tests.
- D. Test Equipment List:
1. The Contractor is responsible for furnishing all test equipment required to test the system in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the system. The Contractor shall furnish test equipment of accuracy better than the parameters to be tested.

2. The test equipment furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
 - a. Spectrum Analyzer.
 - b. Signal Level Meter.
 - c. Volt-Ohm Meter.
 - d. Time Domain Reflectometer (TDR) with strip chart recorder (Data and Optical Measuring).
 - e. Bit Error Test Set (BERT).
 - f. Camera with a minimum of 60 pictures to that will develop immediately to include appropriate test equipment adapters. A video camera in VHS format is an acceptable alternate.
 - g. Video Waveform Monitor.
 - h. Video Vector Scope.
 - i. Color Video Monitor with audio capability.
 - j. 100 mHz Oscilloscope with video adapters
- E. Samples: A sample of each of the following items shall be furnished to the RE for approval prior to installation.
 1. TCO Wall Outlet Box 4" x 4"x 2.5" with:
 - a. One each telephone (or voice) rj45 jack installed.
 - b. Two each multi pin data rj45 jacks installed.
 - c. Cover Plate installed.
 2. Data CCS patch panel, punch block or connection device with RJ45 connectors installed.
 3. Telephone CCS system with IDC and/or RJ45 connectors and cable terminal equipment installed.
 4. Fiber optic CCS patch panel or breakout box with cable management equipment and "ST" connectors installed.
 5. 610 mm (2 ft.) section of each copper cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.
 6. 610 mm (2 ft.) section of each fiber optic cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.
 7. 610 mm (2 ft.) section of each analog RF, video coaxial and audio cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.

8. Analog video CCS patch panel or breakout box with cable management equipment and "BNC" connectors installed.
9. Analog audio CCS patch panel or breakout box with cable management equipment and "XL" connectors installed.
10. Analog RF patch panel or breakout box with cable management equipment and "F" connectors installed.

F. Certifications:

1. Submit written certification from the OEM indicating that the proposed supervisor of the installation and the proposed provider of the contract maintenance are authorized representatives of the OEM. Include the individual's exact name and address and OEM credentials in the certification.
2. Submit written certification from the OEM that the wiring and connection diagrams meet National and/or Government Life Safety Guidelines, NFPA, NEC, UL, this specification, and JCAHCO requirements and instructions, requirements, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. The VA will not approve any submittal without this certification.
3. Preacceptance Certification: This certification shall be made in accordance with the test procedure outlined in paragraph 3.2.B.

G. Equipment Manuals: Fifteen (15) working days prior to the scheduled acceptance test, the Contractor shall deliver four complete sets of commercial operation and maintenance manuals for each item of equipment furnished as part of the System to the RE. The manuals shall detail the theory of operation and shall include narrative descriptions, pictorial illustrations, block and schematic diagrams, and parts list.

H. Record Wiring Diagrams:

1. Fifteen (15) working days prior to the acceptance test, the Contractor shall deliver four complete sets of the Record Wiring Diagrams of the System to the RE. The diagrams shall show all inputs and outputs of electronic and passive equipment correctly identified according to the markers installed on the interconnecting cables, Equipment and room/area locations.
2. The Record Wiring Diagrams shall be in hard copy and two compact disk (CD) copies properly formatted to match the Facility's current operating version of Computer Aided Drafting (AutoCAD) system. The

RE shall verify and inform the Contractor of the version of AutoCAD being used by the Facility.

I. Surveys Required As A Part of the Technical Submittal: The Contractor shall provide the following surveys that depict various system features and capacities are 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:

1. The required EPBX connections (each CSU shall be compatible with) shall be compatible with the following:
 - a. Initially connect:

<u>EQUIPPED ITEM</u>	<u>CAPACITY</u>	<u>WIREDCAPACITY</u>
Main Station Lines		
Single Line		
Multi Line (Equipped for direct input dial [DID])		
Central Office (CO) Trunks		
TWO WAY		
DID		
Two-way DRTL		
Foreign Exchange (FX)		
Conference		
Radio Paging Access		
Audio Paging Access		
Off-Premise Extensions		
CO Trunk By-pass		
CRT w/keyboard		
Printers		
Attendant Consoles		
T-1 Access/Equipment		
Maintenance console		

- b. Projected Maximum Growth: The Contractor shall clearly and fully indicate this category for each item identified in Paragraph 1.4.H.1.a. as a part of the technical submittal. For this

purpose, the following definitions and sample connections are provided to detail the system's capability:

EQUIPPED ITEM	CAPACITY	WIRED CAPACITY
Servers		
PC's		
Projected Maximum Growth		

The Contractor shall clearly and fully indicate this category for each item identified in Paragraph 1.4.H.2.a. as a part of the technical submittal.

2. Cable Distribution System Design Plan: A design plan for the entire cable distribution systems requirements shall be provided with this document. A specific cable count shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems entire cable requirements and engineer a distribution system requirement plan using the format of the following paragraph(s), at a minimum:

- a. UTP (and/or STP) Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
BUILDING	Identifies the building by number, title, or location cabling is to be provided in
TO BUILDING IMC	Identifies building main terminal signal closet, by room number or location, to which cabling is provided too, in, and from
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.) cabling and TCOs are to be provided
TC ROOM NUMBER	Identifies the floor signal closet room, by room number, which cabling shall be provided
ROOM NUMBER	Identifies the room, by number, from which cabling and TCOs shall be provided
NUMBER OF CABLE PAIR	Identifies the number of cable pair required to be provided on each floor designated OR the number of cable pair (VA

	Owned) to be retained
NUMBER OF STRANDS USED/SPARE	Identifies the number of strands provided in each run

b. Fiber Optic Cabling Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
TO BUILDING IMC	Identifies building, by number, title, or location, to which cabling is provided
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
NUMBER OF STRANDS	Identifies the number of strands in each run of fiber optic cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

c. Analog RF Cabling Requirements/Column Explanation:

Column	Explanation
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
TO FLOOR TC	Identifies building, by number or location, to which cabling is installed
NUMBER OF STRANDS	Identifies the number of strands in each run of RF cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title //

d. Analog Video Cabling Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies building, by number or location, from which cabling is installed
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
TO BUILDING IMC	Identifies building, by number or location, to which cabling is installed
TC ROOM NUMBER	Identifies the room, by number, to which cabling shall be installed
NUMBER OF STRANDS	Identifies the number of strands in each run of fiber optic cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

3. Telecommunication Outlets: The Contractor shall clearly and fully indicate this category for each outlet location and compare the total count to the locations identified above as a part of the technical submittal. Additionally, the Contractor shall indicate the total number of spares.

1.6 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. Provide final As Built drawings to COTR in AutoCAD 2007 Format.
- B. The floor plans shall be marked in pen to include the following:
1. All device locations with labels.
 2. Conduit locations.
 3. Head-end equipment and specific location.
 4. Wiring diagram.
 5. Labeling and administration documentation.
 6. Warranty certificate.
 7. System test results.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. System Requirements:

1. The System shall provide the following minimum services that are designed in accordance with and supported by an Original Equipment Manufacturer (OEM), and as specified herein. The System shall provide continuous inter and/or intra-Facility voice and data, and analog RF service. The System shall be capacity sized so that loss of connectivity to external telephone systems shall not affect the Facilities operation in specific designated locations. The System shall:
 - a. Be capable of inter-connecting and functioning fully with the existing Local Telephone Exchange (LEC) Network(s), Federal Telephone System (FTS) Inter-city Network(s), Inter-exchange Carriers, Integrated Services Digital Network (ISDN), Electronic Private Branch Exchange (EPBX) switches, asynchronous/synchronous data terminals and circuits including Automatic Transfer Mode (ATM), Frame Relay, and local area networks (LAN), at a minimum.
 - b. Be a voice and data cable distribution system that is based on a physical "Star" and or "Ring", and or "Bus" Topology. An Analog RF coaxial cable distribution system shall be provided in a "home run" configuration from each associated riser TC to identified locations and as shown on the drawings.
 - c. Be compatible with and able to provide direct digital connection to trunk level equipment including, but, not limited to: directly accessing trunk level equipment including the telephone system, audio paging, Industry Standard "T" and/or "DS" carrier services and external protocol converters. Additionally, connections to "T" and/or "DS" access/equipment or Customer Service Units (CSU) that are used in FTS and other trunk applications shall be included in the System design. Provide T-1 access/equipment (or CSU), as required for use, in FTS and other trunk applications by system design if this equipment is not provided by the existing telephone system and/or will be deactivated by the installation of the System. The Contractor shall provide all T-1 equipment necessary to terminate and make operational the quantity of circuits designated. The CSU's shall be connected to the System's emergency battery power supply. The System shall be fully capable of operating in the Industry Standard "DS" protocol and provide that service when required.

- d. Where the System connects to an existing telephone system, maintain and extend the existing telephone equipment and system operational performance standards.
2. Cable Systems - Twisted Pair and Fiber optic:
 - a. General:
 - 1) The Contractor shall be responsible for providing an extension to the existing system conforming to current and accepted telephone and digital and analog RF industrial/commercial cable distribution standards. The distribution cable installation shall be fully coordinated with the Facility, the PM, the RE and the Contractor prior to the start of installation.
 - 2) The Contractor is responsible for complete knowledge of the space and cable pathways (i.e. equipment rooms, TCs, conduits, wireways, etc.) of the Facility. The Contractor shall at a minimum design and install the System using the Pathway Design Handbook H-088C3, TIA/EIA Telecommunications Building Wiring Standards, and Facility Chief of Information Resource Management's (IRM) instructions, as approved in writing by the PM and/or RE.
 - 3) The System cables shall be fully protected by cable duct, trays, wireways, conduit (rigid, thin wall, or flex), and flexible Innerduct where demonstrated. It is the responsibility of the Contractor to confirm all contract drawings and the Facility's physical layout to determine the necessary cable protective devices to be provided. If flexible innerduct is used, it shall be installed in the same manner as conduit. Open Cable shall be installed per requirements of the NEC and all applicable EIA/TIA Standards for open cable plant.
 - 4) Cable provided in the system (i.e. backbone, outside plant, inside plant, and station cabling) shall conform to accepted industry and OEM standards with regards to size, color code, and insulation. The pair twists of any pair shall not be exactly the same as any other pair within any unit or sub-unit of cables that are bundled in twenty-five (25) pairs or less. The absence of specifications regarding details shall imply that best general industry practices shall prevail and that first quality material and workmanship shall be provided.

Certification Standards, (i.e., EIA, CCITT, FIPPS, and NFPA) shall prevail.

- 5) Some areas of this Facility may be considered "plenum". All wire and cable used in support of the installation in those areas (if any) shall be in compliance with national and local codes pertaining to plenum environments. It is the responsibility of the Contractor to review the VA's cable and wire requirements with the RE and the IRM prior to installation to confirm the type of environment present at each location.
- 6) The Contractor shall provide outside and inside plant cables that furnishes the number of cable pairs required in accordance with the System requirements described herein. The Contractor shall fully coordinate and obtain approval of the design with the OEM, RE and the IRM prior to installation.
- 7) All metallic cable sheaths, etc. shall be grounded by the Contractor (i.e.: risers, underground, station wiring, etc.) as described herein.
- 8) If temporary cable and wire pairs are used, they shall be installed so as to not present a pedestrian safety hazard and the Contractor shall be responsible for all work associated with the temporary installation and for their removal when no longer necessary. Temporary cable installations are not required to meet Industry Standards; but, must be reviewed and approved by the RE and the IRM prior to installation.
- 9) Conductors shall be cabled to provide protection against induction in voice and data and analog RF circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.
- 10) Measures shall be employed by the Contractor to minimize the radiation of RF noise generated by the System equipment so as not to interfere with audio, video, data, computer main distribution frame (MDF), telephone customer service unit (CSU), and electronic private branch exchange (EPBX) equipment the System may service.
- 11) The System's cables shall be labeled on each end and been fully tested and certified in writing by the Contractor to the RE before proof of performance testing can be conducted. The

as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs. Minimum test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on all cables in the frequency ranges specified. The tests required for data cable must be made to guarantee the operation of this cable at not less than 10 mega (m) Hertz (Hz) full bandwidth, fully channel loaded and a Bit Error Rate of a minimum of 10^{-6} at the maximum rate of speed. All cable installation and test records shall be made available at acceptance testing by the RE or Contractor and thereafter maintained in the Facility's Telephone Switch Room. All changes (used pair, failed pair, etc.) shall be posted in these records as the change occurs.

- 12) The Contractor shall coordinate with the LEC to install the telephone entrance cable to the nearest point of entry into the Project Area and as shown on the drawings. The Contractor shall coordinate with the RE and the LEC to provide all cable pairs/circuits from the existing telecommunications riser to the Telephone Room all telephone, FTS, DHCP, ATM, Frame Relay, data, pay stations, patient phones, and any low voltage circuits as described herein.
- 13) The Contractor shall coordinate with the RE and the IRM to install the computer interface cable to the Facility Telephone Switch Room from the Facility's Computer Room for all data, DHCP, FTS, ATM, Frame Relay, and telephone circuits and as shown on the drawings.
- 14) The Contractor shall coordinate with the RE and the IRM to provide all cable pairs/circuits from the Facility Telephone Switch Room and establish circuits into the Facility project area for all voice, data, computer alarm (except fire alarm), private maintenance line, PA, LAN, DHCP, and any low voltage circuits as described herein.
- 15) The Contractor shall provide proper test equipment to guarantee that cable pairs and analog RF coaxial cable meet each OEM's standard transmission requirements, and guarantee the cable will carry data transmissions at the required speeds, frequencies, and fully loaded bandwidth.

- 16) The Contractor shall coordinate with the Facility Chief of Medical Media Production Service (MMPS) to install baseband analog RF, video, and audio interface cables and circuits from each TC to designated TCO locations and as shown on the drawings. The Contractor shall work with the Facility Chief of MMPS to establish circuits throughout the project area and shall provide proper test equipment to guarantee that analog RF, video, and audio cables meet each OEM's standard transmission requirements, and guarantee the cables will carry analog video and audio transmissions at the required speeds, frequencies, and fully loaded bandwidth.
- b. Telecommunications Closets (TC): In TC's that are served with both a UTP and STP backbone cable and a fiber optic backbone cable, the UTP and STP cable shall be terminated on separate RJ-45, 8-pin connectors with 110A or equivalent type punch down blocks located on the back or front of a 48-port modular patch panel dedicated to data applications. Only the UTP and STP backbone cable pairs, identified as being connected to the fiber optic backbone, shall be extended to the fiber optic interface device. All connecting cables required to extend these cables (i.e. patch cords, twenty-five pair connectors, etc.), to the fiber optic interface device, in the TC's shall also be provided by the Contractor to insure a complete and operational fiber optic distribution system:
 - 1) In TC's, which are only served by a UTP and STP backbone cable, the cable shall be terminated on separate modular connecting devices (110A or equivalent) that are dedicated to data applications. In order to provide full service to all data cable pairs as identified in each TC/cabinet including spare capacity noted herein, the size of all vertical (riser) cables and/or outside cables serving these TC's shall be increased as required.
- c. Backbone and Trunk Cables:
 - 1) The Contractor shall identify, in the technical submittal, the voice and data (analog RF coaxial cable shall not be provided in main trunk or backbone lines) connecting arrangements required by the LEC for interconnection of the System to the

commercial telephone and FTS networks. The Contractor shall provide all required voice and data connecting arrangements.

- 2) The Contractor shall be responsible for compatibility of the proposed TCs (to be compliant with the EPBX and CSU equipment) numbering scheme with the numbering plan for the FTS, DID, local stations, and the North American Numbering Plan. The Contractor shall consult with the VA and the LEC regarding the FTS and North American Numbering plan to be implemented for the Facility to ensure system compatibility.
- 3) All submitted equipment shall meet or exceed standards, rules, and regulations of the Federal Communications Commission (FCC) and shall be capable of operating without outboard or "extra" devices. The Contractor shall identify the FCC registration number of the System equipment, EPBX, and proposed CSU (if known) in the technical submittal.

d. Riser Cable:

- 1) All communication riser cables shall be listed as being suitable for the purpose and marked accordingly per Articles 517, 700, and 800 of the NEC.
- 2) All voice and data communication (analog RF coaxial cable is not to be provided in riser systems) riser cables shall be STP or Unshielded Twisted Pair (UTP), minimum 24 American Wire Gauge (AWG) solid, thermoplastic insulated conductors. They shall be enclosed with a thermoplastic outer jacket.
- 3) The Contractor shall provide and install inside riser cables to insure full service to all voice cable pairs identified in each TC terminating enclosure plus not less than 50% additional spare capacity.
- 4) The complete riser cabling system shall be labeled and tested as described herein.

e. Horizontal and Station Cable:

- 1) A Four (4) UTP 24 AWG station wiring cable shall be installed from the top TCO jack to the TC and shall be of a type designed to support Category 6 communications (250 mega-Hertz [mHz] or above). At the jack location, terminate all four pair on the RJ-45/11 jack. At the signal closet, all four pair shall be terminated on the modular punch down blocks dedicated to telephone applications.

- 2) A Four (4) UTP 24 AWG (in thermoplastic jacket unless otherwise specified by RE) station wiring cable shall be installed from each of the two (2) bottom TCO RJ-45 jacks (shall conform to EIA/TIA 568 Standard "T568A" and NFPA) to the TC and shall be of a type designed to support Category 6 communications (250 MHz or above).
- f. Telecommunication Outlets (TCO), Jacks: All TCO's shall have a minimum of three (3) RJ-45 type jacks. The top jack shall be an eight pin RJ-45/11 compatible jack, labeled, and designated for telephone applications only. The bottom two jacks shall be eight pin RJ-45 type unkeyed (sometimes called center keyed) jacks, labeled, and designated for data.
- g. Patient Bedside Prefabricated Units (PBPUs): Where PBPUs exist in the Facility, the Contractor shall identify the single gang "box" location on the PBPUs designated for installation of the telephone jack. This location shall here-in-after be identified as the PBTCO. The Contractor shall be responsible for obtaining written approval and specific instructions from the PBPUs OEM regarding the necessary disassembly and reassembly of each PBPUs to the extent necessary to pull wire from above the ceiling junction box to the PBPUs box reserved for the PBTCO. A Contractor provided stainless steel cover plate approved for use by the PBPUs OEM and Facility IRM Chief shall finish out the jack installation. Under no circumstances shall the Contractor proceed with the PBPUs installations without the written approval of the PBPUs OEM and the specific instructions regarding the attachment to or modifying of the PBPUs. The RE shall be available to assist the Contractor in obtaining these approvals and instructions in a timely manner as related to the project's time constraints. It is the responsibility of the Contractor to maintain the UL integrity of each PBPUs. If the Contractor violates that integrity, it shall be the responsibility of the Contractor to obtain on site UL re-certification of the violated PBPUs at the direction of the RE and at the Contractor's expense.
- h. Fiber Optics:
- 1) A fiber optic cable distribution system shall be provided as a part of the Data System. The Contractor shall provide a fiber optic cable that meets the minimum bandwidth requirements for

FDDI, ATM, and Frame Relay services. This fiber optic cable shall be a 62.5/125 50/125 micron multi-mode, containing a minimum of 4 - 1 pairs of fiber, unless otherwise specified, and shall not exceed a distance of 2,000 Meters (M), or 6,560 feet (ft.) in a single run. Loose tube cable, which separates the individual fibers from the environment, shall be installed for all outdoor runs or for any area which includes an outdoor run. Tight buffered fiber cable shall be used for indoor runs. The multimode fibers shall be terminated and secured at both ends in "ST" type female stainless steel connectors installed in an appropriate patch or breakout panel with a cable management system. A 610 mm (2 ft.) cable loop (minimum) shall be provided at each end to allow for future movement.

- 2) The fiber optic backbone shall use a conventional hierarchical "star" design where each TC is wired to the primary hub (main cross-connect system) or a secondary hub (intermediate cross-connect system) and then to the primary hub. There shall be no more than two hierarchical levels of cross-connects in the backbone wiring. Each primary hub shall be connected and terminated to a CCS in the Telephone Switch Room. Additionally, a parallel separate fiber optic interconnection shall be provided between the Telephone Switch Room CCS and the MDF in the Main Computer Room.
- 3) In the TC's, Telephone Switch Room, and Main Computer Room, all fiber optic cables shall be installed in a CCS and/or MDF rack mounted fiber optic cable distribution component/splice case (Contractor provided and installed rack), patch, or breakout panel in accordance with industry standards. Female "ST" connectors shall be provided and installed on the appropriate panel for termination of each strand.
- 4) The Contractor shall test each fiber optic strand. Cable transmission performance specifications shall be in accordance with EIA/TIA standards. Attenuation shall be measured in accordance with EIA fiber optic test procedures EIA/TIA-455-46, -61, or -53 and NFPA. Information transmission capacity shall be measured in accordance with EIA/TIA-455-51 or -30 and NFPA. The written results shall be provided to the RE for review and approval.

3. Specific Subsystem Requirements: The System shall consist, as a minimum, of the following independent sub-systems to comprise a complete and functional voice and digital telecommunications cabling system: "Main" (MTC), "intermediate" (IMTC), and "riser" (RTC) TC's; "backbone" cabling (BC) system; "vertical" (or "riser") trunk cabling system; "horizontal" (or "lateral") sub-trunk cabling system, vertical and horizontal cross-connection (VCC and HCC respectively) cabling systems, and TCO's with a minimum of three (3) RJ-45 jacks for the appropriate telephone, Data connections, and additional jacks, connectors, drop and patch cords, terminators, and adapters provided.

a. Telecommunication Closet (TC):

- 1) There shall be a minimum of one TC for the MTC, each building IMTC, and each RTC per building floor location. However, in large building(s), where the horizontal distance to the farthest voice and digital work area may exceed 90 Meters (M) (or 295 feet [ft]), additional TC's shall be provided as described herein. The maximum DC resistance per cable pair shall be no more than 28.6 Ohms per 305 M (1,000 feet). Each TC shall be centrally located to cover the maximum amount of local floor space. The TC's house in cabinets or enclosures, on relay racks, and/or on backboards, various telecommunication data equipment, controllers, multiplexers, bridges, routers, LAN hub(s), telephone cross-connecting, active and passive equipment.
- 2) Additionally, the TC's may house fire alarm, nurses call, code one (or blue), video, public address, radio entertainment, security, intercom, and radio paging equipment. Regardless of the method of installation, mounting, termination, or cross-connecting used, all backbone, vertical, and horizontal copper and fiber optic and analog RF coaxial cables shall be terminated on appropriate cross-connection systems (CCS) containing patch panel(s), punch blocks, and/or breakout devices provided in enclosures and tested as described herein. A cable and/or wire management system shall be a part of each CCS.
 - a) A minimum of three 110-120 VAC active quad outlets shall be provided, each with "U" grounded receptacles at a minimum

of one outlet for each front, side and back wall. These outlets shall be separately protected by an AC circuit breaker provided in the designated Government Emergency Critical Care AC power panel, that is connected to the Facilities Emergency AC Power Distribution System. For larger building TC applications, a minimum of one additional quad AC outlet shall be provided for every 800M² (or 8,000 ft²) of useable floor space. Additional outlets shall be equally spaced along the wall.

- b) Climate control shall be provided in each TC 24 hours a day, seven days per week and 52 week per year to prevent failure of electronic components and for mission critical functional applications. The PM and/or Facility Chief Engineering Officer are responsible for informing the Contractor regarding the minimum climate control requirements. In identified hostile TC locations where it has been determined (by the RE or Facility Chief Engineer) that proper TC climate or external signal radiation cannot be properly maintained or controlled, the Contractor may, at his/her option, provide a minimum of two individual and properly sized self contained climate controlled equipment cabinet enclosures; one designated for voice, and one designated for data , and one additional cabinet designated for analog RF service, in each TC location identified on the drawings, in lieu of providing additional required TC air handling capability.

b. Cross-connect Systems (CCS):

- 1) The CCS shall be selected based on the following criteria:
requires the use of a single tool, has the fewest amount of parts, and requires the least amount of assembly or projected trouble shooting time during the life of the system.
- 2) The CCS system used at the MTC, each IMTC, and each TC shall force cross-connect cable slack management through adherence to the OEM's installation methods, provided cable management systems, and as described herein, so that moves, adds, and changes can be administered easily and cost effectively.
- 3) Copper Cables: The MTC, each IMTC, and TC shall contain a copper CCS sized to support the System TCO's and connections

served by each individual TC and as shown on the drawings. The System layout shall allow for a minimum of 50% anticipated growth. Additionally, each CCS must provide maximum flexibility, while maintaining performance, in order to meet system-changing requirements that are likely to occur throughout its useful life.

4) Fiber Optic Cables:

- a) The MTC and each TC shall contain a fiber CCS sized to support the System TCO's and connections served by each individual TC and as shown on the drawings. The System layout shall allow for a minimum of 50% anticipated growth.
- b) Each fiber CCS must provide maximum flexibility and cable management while maintaining performance in order to meet changing requirements that are likely to occur throughout the expected life of the system. All fiber optic cable slack shall be stored in protective enclosures.
- c) If it is determined that a fiber optic distribution system is not necessary for the immediate system needs. Each TC shall be provided with fiber optic cable(s) that contain a minimum of 4 - 1 pair "dark" multimode fiber, each fiber properly terminated on its respective female stainless steel connector mounted in an appropriate fiber termination enclosure provided in each TC.

5) The Contractor shall not "cross-connect" the copper or fiber optic cabling systems and subsystems even though appropriate "patch" cords are to be provided for each "patch", "punch", or "breakout" panel. In addition, the Contractor shall not provide active electronic distribution or interface equipment as a part of the System.

6) Grounding: Proper grounding and bonding shall be provided for each TC and all internal equipment. Reference shall be made to proper codes and standards, such that all grounding systems must comply with all applicable National, Regional, and Local Building and Electrical codes. The most stringent code of these governing bodies shall apply.

- a) If local grounding codes do not exist for the System location, then at a minimum, a #6 American Wire Gauge (AWG) stranded copper wire, or equivalent copper braid, shall be

connected to a separate earth grounding system for each TC (the looping of TC's in a general location is allowed as long as the specifications contained herein are met). Under no circumstance shall the AC neutral be used for this ground. See PART 3 - EXECUTION for specific grounding instructions.

- b) Each copper UTP or STP cable that enters a TC from the outside of a building (regardless if the cable is installed underground or aerial) shall be provided with a surge protector and grounded an to earth ground at each cable's entry point in and out of the MTC and each IMTC.
- c. Main Cross-connection Subsystem (MCCS): The MCCS shall be located in the MTC and it shall be the common point of appearance for inter and intra-building copper and fiber optic "backbone" system cables, and connections to the telephone and data cable systems. The MTC usually houses telephone EPBX, public address, radio paging interface, routers, and main hierarchical data LAN concentrating equipment. Additionally, it shall provide a single administration and management point for the entire System.
- d. Voice (or Telephone) Cable Cross-Connection Subsystem:
 - 1) Due to the usually high number of copper cable termination's required at the MCCS, Insulation Displacement Connection (IDC) hardware shall be used. Termination options shall include the following for a Category 6 Cabling System: IDC termination of cross-connection wire(s), IDC patch cord connector to IDC patch cord connector, and hybrid modular cord to IDC patch cord connector shall be the minimum provided.
 - 2) Additionally, due to the large or many MCCS (at initial installation and over the life of the System) copper termination points, the CCS that makes the best use of real estate while still following the OEM design and installation guidelines, and meeting the specifications described herein, shall be provided.
 - 3) For ease of maintenance purposes, all terminations shall be accessible without the need for disassembly of the IDC wafer. IDC wafers shall be removable from their mounts to facilitate testing on either side of the connector. Designation strips or labels shall be removable to allow for inspection of the

terminations. The maximum number of terminations on a wall or on a rack frame or panel shall comply with the OEM recommendations and guidelines, and as described herein. A cable management system shall be provided as a part of the IDC.

- 4) IDC connectors shall be capable of supporting cable re-terminations without damaging the connector and shall support a minimum of 200 (telephone equipment standard compliant) IDC insertions or withdrawals on either side of the connector panel.
 - 5) A non-impact termination method using a full-cycle terminating tool having both a tactile and an audible feedback to indicate proper termination is required. For personnel safety and ease of use in day to day administration, high impact installation tools shall not be used.
 - 6) All system "inputs" from the EPBX, FTS, Local Telephone System, or diverse routed voice distribution systems shall appear on the "left" side of the IDC (110A blocks with RJ45 connections are acceptable alternates to the IDC) of the MCCS.
 - 7) All system "outputs" from the MCCS to the voice backbone cable distribution system shall appear on the "right" side of the same IDC (or 110A blocks) of the MCCS.
 - 8) The splitting of pairs within cables between different jacks or connections shall not be allowed. In the case of ISDN and/or ATM and /or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
 - 9) UTP or STP cross connecting wires shall be provided for each "pair" of connection terminals plus an additional 50% spare.
- e. Data Cross-Connection Subsystems:
- 1) The MCCS shall be a Main Distribution Terminating (MDT) data unit and shall be provided in the MTC. The MDT shall consist of a "patch" panel(s) provided with modular RJ45 female connectors for cross-connection of all copper data cable terminations. The panels shall provide for system grounding (where no dielectric cables are used) and be provided with a cable management system.

- 2) Each panel shall conform to EIA dimensions and be suitable for mounting in standard equipment racks, have the RJ45 jacks aligned in two horizontal rows (up to a maximum of 48 jacks per panel), and shall not exceed the OEM's recommendations. Each RJ45 jack shall be of modular design and capable of accepting and functioning with other modular (i.e. RJ11) plugs without damaging the jack. It is not necessary to provide a jack for unused positions that are not part of the 50% expansion requirement.
 - a) All data system inputs from the server(s), data LAN, bridge, or interface distribution systems shall appear on the "top" row of jacks of the appropriate patch panel.
 - b) All System outputs or backbone cable connections shall appear on the "bottom" row of jacks of the same patch panel.
 - c) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and/or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
- 3) A patch cord shall be provided for each system "pair" of connection jacks. Each patch cord shall have modular RJ45 connectors provided on each end to match the panel's modular RJ45 female jack's being provided.
- f. Fiber optic Cross-Connection Subsystems: The MTC shall be provided with a separate fiber MCCS. Each TC shall be provided with a rack mounted patch or distribution panel that is installed inside a lockable cabinet or "breakout enclosure" that accommodates a minimum of 12 strands multimode fiber and 12 strand single mode fiber (these counts shall not be included the 50% spare requirement). Two of the single mode fibers shall be designated for educational analog video applications. A cable management system shall be provided for each panel.
 - 1) The panel(s) shall contain a minimum of 24 female "ST" connectors, be able to accommodate splices and field mountable connectors and have capacity for additional connectors to be added up to the OEM's maximum standard panel size for this

type of use. All patch panel sides, including the front and back, shall be protected by a cabinet or enclosure.

- 2) The panel(s) shall conform to EIA dimensions and be suitable for installation in standard racks, cabinets, and enclosures. The panels shall provide for system grounding (where no dielectric cables are used).
- 3) The patch panel with the highest OEM approved density of fiber "ST" termination's (maximum of 72 each), while maintaining a high level of manageability, shall be selected. Patch cables, with proper "ST" connectors installed on each end shall be provided for each pair of fiber optic cable "ST" connectors.
 - a) All System "inputs" from interface equipment or distribution systems shall appear on the "top" row of connectors of the appropriate patch panel.
 - b) All System "outputs" or backbone cable connections shall appear on the "bottom" row of connectors of the same patch panel.
- 4) In order to achieve a high level of reliability that approximates that of an OEM connector, field installable connectors shall have an OEM specified physical contact polish. Every fiber cable shall be terminated with the appropriate connector, and tested to ensure compliance to OEM and specifications outlines herein. Where a local fiber optic system connector standard, Industry Standard fiber optic "ST" female connector terminated with a fiber optic cable, shall be used. But, if the fiber optic cable is not used (or "dark"), a "ST" male terminating "cap" shall be provided for each unused "ST" female connector.
- g. Intermediate Cross-connection Subsystems (IMCCS): The MTC and each IMTC shall be provided with an IMCCS that shall be the connection point between the MCCA system and the distribution backbone cable and the IMCCS, that is located in one or more buildings on a campus, where each IMCCS is placed by system design. For a technical explanation of internal equipment and system requirements, refer to the above MTC and MCCA paragraphs.
- h. Distribution Cable Systems / Backbone Cable System (Common to Inter-buildings): The backbone cable system extends from the MCCA to each IMCCS to establish service between buildings on a campus.

The media (copper and fiber optic) used in the BC system shall be designed according to the system requirements, OEM standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic backbone system shall be provided as a part of the BC distribution system.

- 1) All outside cable shall be minimum of STP or UTP, 22 AWG solid conductors, solid PVC insulation, and filled core (flexgel - waterproof Rural Electric Association (REA) LISTED PE 39 CODE) between the outer armor or jacket and inner conductors protective lining.
- 2) The copper cable system shall be configured as a "Star" Topology with separate dedicated cables between the MCCA and each IMCCA.
- 3) UTP and STP copper cables shall consist of thermoplastic insulated conductors formed into binder groups. The groups are to be identified by distinctly colored binders and assembled to form a single compact core covered by a protective sheath. Each cable shall be rated for Category 6 Telecommunications System Service. A minimum of eight pairs per circuit, plus an additional 50% spare for growth shall be provided.
- 4) Where the distance limitations of UTP or STP may be exceeded, multimode fiber optic cable(s) shall be used to augment the voice and/or data backbone cable system(s). The total loss of each fiber shall not exceed 12 decibel (dB) at 850 nano-Meter (nm), 11 dB at 1,300 nm, or 10 dB at 1,500 nm.
- 5) All voice system "inputs" from the MCCA via the BC distribution system shall appear on the "left" side of IDC (minimum 110 blocks) punch terminals of the IMCCA.
- 6) All voice system "outputs" or trunk line connections shall appear on the "right" side of the same IDC (minimum 110 blocks) of the IMCCA.
- 7) All data system "inputs" from the MCCA via the BC distribution system shall appear on the "top" row of jacks of the appropriate patch panel of the IMCCA.
- 8) All data system "outputs" or trunk line connections shall appear on the "bottom" row of jacks in the same patch panel of the IMCCA.

- 9) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and /or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
 - 10) A patch cord shall be provided for each system "pair" of connection jacks. Each patch cord shall have modular connectors provided on each end to match the panel's modular female jack.
 - 11) The fiber optic BC system shall be configured as a "Buss" Topology with separate dedicated fibers between the M CCS and each IM CCS. The System shall be sized to meet the system requirements plus an expansion capability of 50%. Fiber optic cable(s) having a minimum of 12 strands multimode fiber and 12 strands single mode fiber shall be provided. Two of the single mode fibers shall be designated for analog video service.
 - 12) All BC shall be identified with permanent labels at both ends. Labels will indicate system, floor, closet, and zone. The label designations shall match those used for cross-connect terminals and patch panels.
- i. Distribution (Common to Intra-Building) Cabling Systems: The intra-building trunk cabling system provides for connection between the IM CCS and each Riser TC's provided vertical cross-connecting system (V CCS) within a building. The media (copper, fiber optic, and RF coaxial) used in the intra-building backbone cabling system shall be designed according to the system requirements, OEM standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic, and analog RF coaxial trunk system shall be provided as a part of the System.
- 1) Category 6 UTP or STP multi-pair trunk cable(s) shall be used in the voice and data trunk-line-cabling systems. A minimum of eight pairs per circuit, plus an additional 50% spare for growth shall be provided.
 - 2) Where the distance limitations of UTP and/or STP will be exceeded, multimode fiber optic cable shall be used in the voice and/or trunk cabling systems. The total loss of the fiber trunks shall not exceed 12 dB at 850 nM, 11 dB at 1,300 nM, or 10 dB at 1,500 nM.

- a) All voice system "outputs" from the IMCCS to the trunk-line distribution system shall appear on the "right" side of IDC (minimum 110A blocks) punch terminals of the IMCCS.
 - b) All data system "outputs" from the IMCCS to the trunk-line distribution system shall appear on the "bottom" row of jacks of the same IDC (minimum 110A blocks) of the IMCCS.
 - c) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and/or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
 - d) A patch cord shall be provided for each system "pair" of connection jacks. Each patch cord shall have modular connectors provided on each end to match the panel's modular female jack.
- 3) The fiber optic trunk line system shall be configured as a "Buss" Topology with separate dedicated fibers between the IMCCS and each RCS. The System shall be sized to meet the System requirements with a expansion capability of 50% provided. Separate individual fiber optic cable(s) with a minimum of 4 - 1 pair multimode fiber shall be provided.
- 4) All trunk lines shall be identified with permanent labels at both ends. Labels will indicate system, floor, closet, and zone. The label designations shall match those used for cross-connects and patch panels.
- a) All System outputs from the IMCCS to the trunk-line distribution system shall appear on the "bottom" row of "ST" connectors in the appropriate patch panel.
 - b) A patch cord shall be provided for each system "pair" of connection "ST" connectors. As a minimum, each patch cord shall have "ST" male connectors provided on each end to match the panel's female "ST" connector provided.
- j. VCCS and Horizontal Cross-connecting (HCCS) systems: Each TC shall be provided with a separate VCCS and HCCS located within the TC. The VCCS and HCCS shall interconnect and interface the riser (vertical) trunk line cables with the horizontal (or station) sub-trunk line cables. The media (copper, fiber optic and analog RF coaxial used in the CCS system shall be designed

according to the System requirements, OEM standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic and RF coaxial CCS system shall be provided as a part of the System.

- 1) The UTP, STP, and fiber optic and RF coaxial trunk-line cabling systems are that connected between the trunk-lines and Riser VCCS, shall be terminated:
 - a) On the "left" or "top" IDC (or 110A blocks) for each UTP or STP voice cable.
 - b) On the "top" row of RJ45 jacks on the appropriate patch panel for each UTP or STP data cable.
 - c) On the "top" row of "ST" connectors on the appropriate patch panel for each fiber and "F" connectors for each analog RF coaxial cable.
- 2) The UTP, STP, and fiber optic and analog RF coaxial sub-trunk (lateral) floor distribution cabling systems that are connected between each RTC and each TCO or secondary system distribution or connection point, shall terminate on an appropriate HCCS, at the:
 - a) On the "right" IDC (or 110A block) used as the VCCS input for each UTP or STP voice cable.
 - b) On the "bottom row of RJ45 jacks on the appropriate patch panel used as the VCCS input for each UTP or STP data cable.
 - c) On the "bottom" row of "ST" connectors on the appropriate patch panel used as the VCCS input for each fiber and "F" connectors for each analog RF coaxial cable.
 - d) The technical requirements of the VCCS and HCCS "patch", "terminating", or "breakout" panels and cable management assemblies for voice, data and fiber optic (and RF coaxial) cables shall be as described in the above MCCS, IMCCS, and TC technical paragraphs.
- 3) The Contractor shall not "cross-connect" the VCCS or HCCS cabling systems even though appropriate patch cords are provided for each "patch", "punch", or "breakout" panel. Also, the Contractor shall not provide active interface or distribution electronic equipment as a part of the System.

- k. Horizontal (or Station) Cabling (HC): The HC distribution cabling systems connects the distribution field of the voice and data HCCS, in a "Star" Topology, to each TCO or connector and as shown on the drawings via the sub-trunk system.
- 1) Horizontal cables shall consist of insulated, UTP or STP conductors that are rated for Category 6 telecommunications service for voice and data systems.
 - 2) The number of UTP or STP distribution pairs dedicated to each floor from the HC shall be sufficient to accommodate all the horizontal voice and data circuits served by the distribution cable to each TCO.
 - a) A minimum of four pairs for voice shall be connected to the "right" side of the IDC (or 110A block) that the VCCS "input" connections appear in the RTC.
 - b) A minimum of two separate sets of four pairs each for data shall be connected to the "bottom" row of RJ45 jacks that the VCCS "input" connections appear in the RTC.
 - 3) The horizontal cable length to the farthest system outlet shall be limited to a maximum of 90M (or 295 ft). These maximum lengths must be derated, adjusted and reduced to include cross-connection and distribution system losses. Additional TC(s) shall be provided on large floor areas of buildings to limit the horizontal distribution to a maximum of 90M (or 295 ft).
 - 4) The splitting of pairs within a cable between different jacks shall not be permitted.
 - 5) The installation of the HC shall conform to appropriate OEM recommendations and standards outlined herein. This requirement will insure adequate protection for Electro-Magnetic Interference (EMI) sources.
 - 6) A system design where "looping" the HC distribution cables from room to room shall not be permitted.
- l. System Telecommunication Outlets (TCO): The System shall be capable of receiving the specified telephone (or voice) and data signals acquired from the LEC, FTS contracted carrier and computer system and shall process and distribute them to the designated TCO's and as shown on the drawings. At a minimum, one TCO shall be provided on each room wall, associated with an

active 120 VAC shall be provided and as shown on the drawings. The only exception to the general rule, of one outlet per wall, shall be those "special" locations (e.g., surgical suites, radiology MRI rooms, labs, patient bed rooms, warehouse, loading docks, storage rooms, etc.) where there is usually only one TCO provided as designated on the drawings.

- 1) Each TCO shall consist of three multipin modular RJ45 jacks, one designated for telephone and two for data service, Each TCO with appropriate jacks installed shall be provided by the Contractor in each designated location and as shown on the drawings.
- 2) The Contractor shall connect each telephone multipin modular RJ45 jack to a separate "right side as you look at it" telephone HC distribution system HCCS "punch down" 110A block or approved IDC terminating device in each associated RTC. The modular RJ45 jack shall be able to accept and operate with smaller modular RJ11 plugs while providing proper connection and not damaging the modular jack. The OEM shall warrant all modular RJ45/11 jacks in such a manner to be usable for modular RJ11 plugs.
- 3) The Contractor shall connect each TCO data multipin modular RJ45 jack to a separate lower row jack on the HCCS "patch panel" in each associated RTC. The Contractor is not to "cross-connect" VCCS and HCCS data distribution cables or provides active electronic data distribution equipment as a part of the System.
- 4) A non-impact termination method, using either a stuffer cap with installation tool or full-cycle terminating tool having both tactile and audible feedback to indicate proper termination shall be used. High impact installation tools shall not be used.
- 5) Each terminated conductor end shall be properly trimmed to assure a minimum clearance of 6.35 mm (0.250 in) clearance between the conductors of adjacent modules.
- 6) The multipin RJ45 jack shall be modular in construction that will accept and operate with a modular UTP and STP RJ45 connector and its pin assignments.

B. System Performance:

1. At a minimum, the System shall be able to support the following voice and data and analog RF operations for Category 6 Certified Telecommunication Service:
 - a. Provide the following interchange (or interface) capabilities:
 - 1) Basic Rate (BRI).
 - 2) Primary Rate (PRI).
 - b. ISDN measured at the TE1 Device:
 - 1) Narrow Band BRI.
 - a) B Channel: 64 kilo-Bits per second (kBps), minimum.
 - b) D Channel: 16 kBps, minimum.
 - c) H Channel: 384 kBps, minimum.
 - 2) Narrow Band PRI:
 - a) B Channel: 64 kBps, minimum.
 - b) D Channel: 64 kBps, minimum.
 - c) H Channel: 1,920 kBps, minimum.
 - 3) Wide (or Broad) Band:
 - a) All channels: 140 mega(m)-Bps, minimum, capable to 565 mBps at "T" reference.
 - c. ATM operation and interface: ATM 155 mBps measured at the existing Switch.
 - d. Frame Relay: All stated compliance's measured at the ISDN Switch.
 - e. Integrated Data Communications Utility (IDCU) operation and interface: Insure Compliance with existing Interfaces.
 - f. Government Open Systems Interconnection Profile (GOSSIP) compliant: Measured at NIST for compliance with FIPS 146-2.
 - g. Fiberoptic Distributed Data Interface (FDDI): A minimum 100 mBps to a maximum of 1.8 giga(g)-Bps data bit stream speed measured between FDDI Boards. (shall be Synchronous Optical Network [Sonet] compliant).
 - h. System Sensitivity: Satisfactory service shall be provided for at least 3,000 feet for all voice and data locations.
2. At a minimum the System shall support the following operating parameters:
 - a. EPBX connection:
 - 1) System speed: 1.0 gBps per second, minimum.
 - 2) Impedance: 600 Ohms.
 - 3) Cross Modulation: -60 deci-Bel (dB).

- 4) Hum Modulation: -55 Db.
- 5) System data error: 10 to the -10 Bps, minimum loss measured at the frame output with reference Zero (0) deciBel measured (dBm) at 1,000 Hertz (Hz) applied to the frame input.
 - a) Trunk to station: 1.5 dB, maximum.
 - b) Station to station: 3.0 dB, maximum.
 - c) Internal switch crosstalk: -60 dB when a signal of ± 10 deciBel measured (dBm), 500-2,500 Hz range is applied to the primary path.
 - d) Idle channel noise: 25 dBm "C" or 3.0 dBm "O" above reference (terminated) ground noise, whichever is greater.
 - e) Traffic Grade of Service for Voice and Data:
 - (1) A minimum grade of service of P-01 with an average traffic load of 7.0 CCS per station per hour and a traffic overload in the data circuits will not interfere with, or degrade, the voice service.
 - (2) Average CCS per voice station: The average CCS capacity per voice station shall be maintained at 7.0 CCS when the EPBX is expanded up to the projected maximum growth as stated herein.

b. Telecommunications Outlet (TCO):

- 1) Voice:
 - a) Isolation (outlet-outlet): 24 dB.
 - b) Impedance: 600 Ohms, balanced (BAL).
 - c) Signal Level: 0 deciBel per mili-Volt (dBmV) ± 0.1 dBmV.
 - d) System speed: 100 mBps, minimum.
 - e) System data error: 10 to the -6 Bps, minimum.
- 2) Data:
 - a) Isolation (outlet-outlet): 24 dB.
 - b) Impedance: 600 Ohms, BAL.
 - c) Signal Level: 0 dBmV ± 0.1 dBmV.
 - d) System speed: 120 mBps, minimum.
 - e) System data error: 10 to the -8 Bps, minimum.

C. General:

- 1. All equipment to be supplied under this specification shall be new and the current model of a standard product of an OEM or record. An OEM of record shall be defined as a company whose main occupation is

- the manufacture for sale of the items of equipment supplied and which:
- a. Maintains a stock of replacement parts for the item submitted.
 - b. Maintains engineering drawings, specifications, and operating manuals for the items submitted.
 - c. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid.
2. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity, or performance characteristics of items furnished in the System. When the Contractor furnishes an item of equipment for which there is a specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.
 3. The Contractor shall provide written verification, in writing to the RE at time of installation, that the type of wire/cable being provided is recommended and approved by the OEM. The Contractor is responsible for providing the proper size and type of cable duct and/or conduit and wiring even though the actual installation may be by another subcontractor.
 4. The Telephone Contractor is responsible for providing interfacing cable connections for the telephone, PA and other necessary systems with the System.
 5. The telephone equipment and PA interface equipment shall be the interface points for connection of the PA interface cabling from the telephone switch via the system telephone interface unit.
 6. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC standards for telephone equipment, systems, and service.
 7. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.
 8. All interconnecting twisted pair, fiber-optic or coaxial cables shall be terminated on equipment terminal boards, punch blocks, breakout boxes, splice blocks, and unused equipment ports/taps shall be terminated according to the OEM's instructions for telephone cable systems without adapters. The Contractor shall not leave

unused or spare twisted pair wire, fiber-optic, or coaxial cable unterminated, unconnected, loose or unsecured.

9. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, and this document, which ever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance. Reference Specification SECTION 16127, CABLES, LOW VOLTAGE (600 VOLTS AND BELOW.
 10. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and interface points. Tape of any type, wire nuts, or solder type connections are unacceptable and will not be approved.
 11. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cycolac plastic for the areas where provided.
 12. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low Voltage data circuits.
- D. Equipment Functional Characteristics:

FUNCTIONS	CHARACTERISTICS
Input Voltage	105 to 130 VAC
POWER LINE FREQUENCY	60 HZ ±2.0 HZ
Operating Temperature	0 to 50 degrees (°) Centigrade (C)
Humidity	80 percent (%) minimum rating

E. Equipment Standards and Testing:

1. The System has been defined herein as connected to systems identified as Critical Care performing Life Support Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Life Safety Codes (which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.

2. All supplies and materials shall be listed, labeled or certified by UL or a nationally recognized testing laboratory where such standards have been established for the supplies, materials or equipment. See paragraph minimum requirements SECTION 16050, BASIC METHODS AND REQUIREMENTS (ELECTRICAL), and the guidelines listed in paragraph 2.J.2.
3. The provided active and passive equipment required by the System design and approved technical submittal 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.

2.2 EQUIPMENT ITEMS

A. Backboard:

1. The provided fire rated plywood backboard.
2. Backboard size shall match requirements as demonstrated on the floor plans.
3. Refer to VA Handbook H-088C3, Telephone System Requirements, for specific TC guidelines for size, power input, security, and backboard mounting requirements.

B. Cross-Connection System (CCS) Equipment Breakout, Termination Connector (or Bulkhead), and Patch Panels:

1. The connector panel(s) shall be made of flat smooth 3.175 mm (1/8 in.) thick solid aluminum, custom designed, fitted and installed in the cabinet. Bulkhead equipment connectors shall be mounted on the panel to enable all cabinet equipment's signal, control, and coaxial cables to be connected through the panel. Each panel shall be color matched to the cabinet installed.

a. Voice (or Telephone):

- 1) The CSS for voice or telephone service shall be Industry Standard type 110 (minimum) punch blocks for voice or telephone, and control wiring in lieu of patch panels, each

being certified for category six service. IDC punch blocks (with internal RJ45 jacks) are acceptable for use in all CCS and shall be specifically designed for category six telecommunications service and the size and type of UTP cable used as described herein. As a minimum, punch block strips shall be secured to an OEM designed physical anchoring unit on a wall location in the MTC, IMTC, RTC, and TC. However, console, cabinet, rail, panel, etc. mounting is allowed at the OEM recommendation and as approved by the RE. Punch blocks shall not be used for Class II or 120 VAC power wiring.

2) Technical Characteristics:

Number of horizontal rows	100, MINIMUM
Number of terminals per row	4, minimum
Terminal protector	required for each used or unused terminal
Insulation splicing	required between each row of terminals

b. Digital or High Speed Data:

- 1) The CSS for digital or high-speed data service shall be a patch panel with modular female RJ45 jacks installed in rows. Patch panels and RJ45 jacks shall be specifically designed for category six telecommunications service and the size and type of UTP or STP cable used. Each panel shall be 480 mm (19in.) horizontal EIA rack mountable dimensions with EIA standard spaced vertical mounting holes.

2) Technical Characteristics:

Number of horizontal rows	2, minimum
Number of jacks per row	24, MINIMUM
Type of jacks	RJ45
Terminal protector	required for each used or unused jack
Insulation	required between each row of jacks

- c. Punch Blocks: As a minimum, Industry Standard 110 type punch blocks are approved for data, voice, and control wiring. Punch blocks shall

be specifically designed for the size and type of wire used. Punch block strips shall be secured to a console, cabinet, rail, panel, etc. Punch blocks shall not be used for Class II or 120 VAC power wiring.

- d. Wire Wrap Strips: Industry Standard wire wrap strips (16.5 mm (0.065in.) wire wrap minimum) are approved for data, voice and control wiring. Wire wrap strips shall be secured to a cabinet, rail, panel, etc. Wire wrap strips shall not be used for Class II or 120 VAC power wiring.

C. Wire Management System and Equipment:

1. Wire Management System: The system(s) shall be provided as the management center of the respective cable system, CCS, and TC it is incorporated. It shall perform as a platform to house peripheral equipment in a standard relay rack or equipment cabinet. It shall be arranged in a manner as to provide convenient access to all installed management and other equipment. All cables and connections shall be at the rear of each system interface to IDC and/or patch panels, punch blocks, wire wrap strips, and/or barrier strip.
2. Wire Management Equipment: The wire management equipment shall be the focal point of each wire management system. It shall provide an orderly interface between outside and inside wires and cables (where used), distribution and interface wires and cables, interconnection wires and cables and associated equipment, jumper cables, and provide a uniform connection media for all system fire retardant wires and cables and other subsystems. It shall be fully compatible and interface to each cable tray, duct, wireway, or conduit used in the system. All interconnection or distribution wires and cables shall enter the system at the top (or from a wireway in the floor) via a overhead protection system and be uniformly routed down either side (or both at the same time) of the frames side protection system then laterally via a anchoring or routing shelf for termination on the rear of each respective terminating assembly. Each system shall be custom configured to meet the System design and user needs.

2.3 DISTRIBUTION EQUIPMENT AND SYSTEMS

A. Telecommunication Outlet (TCO):

1. The TCO shall consist of one telephone multipin jack and two data multipin jacks mounted in a steel outlet box. A separate 100mm

- (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a labeled stainless steel faceplate will be used. A second 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a labeled faceplate shall be provided as required adjacent to the first box to ensure system connections and expandability requirements are met.
2. All telephone multipin connections shall be RJ-45/11 compatible female types. All data multipin connections shall be RJ-45 female types. All fiber optic (single mode and multimode) connections shall be "ST" stainless steel female types. All analog RF, video, and audio connections shall be "F", "BNC", or "XL" female types respectively.
 3. The TCO shall be fed from the appropriate CCS located in the respective RTC in a manner to provide a uniform and balanced distribution system.
 4. Interface of the data multipin jacks to appropriate patch panels (or approved "punch down" blocks) in the associated RTC, is the responsibility of the Contractor. The Contractor shall not extend data cables from the RTCs to data terminal equipment or install data terminal equipment.
 5. The wall outlet shall be provided with a stainless steel or approve alternate cover plate to fit the telephone multipin jack, data multi-pin jacks , fiber optic jacks , analog jack(s) and the outlet box provided (100mm (4in.) x 100mm (4in.) for single and 100mm (4in.) x 200mm (8in.) for dual outlet box applications). For PBPU installations, the cover plate shall be stainless steel.
- B. Distribution Cables: Each cable shall meet or exceed the following specifications for the specific type of cable. Each cable reel shall be sweep tested and certified by the OEM by tags affixed to each reel. The Contractor shall turn over all sweep tags to the RE or PM. Additionally, the Contractor shall provide a 610 mm (2 ft.) sample of each provided cable, to the RE and receive approval before installation. Cables installed in any outside location (i.e. above ground, under ground in conduit, ducts, pathways, etc.) shall be filled with a waterproofing compound between outside jacket (not immediately touching any provided armor) and inter conductors to seal punctures in the jacket and protect the conductors from moisture.

1. Remote Control:

- a. The remote control cable shall be multi-conductor with stranded (solid is permissible) conductors. The cable shall be able to handle the power and voltage necessary to control specified system equipment from a remote location. The cable shall be UL listed and pass the FR-1 vertical flame test, at a minimum. Each conductor shall be color-coded. Combined multi-conductor and coaxial cables are acceptable for this installation, as long as all system performance standards are met.
- b. Technical Characteristics:

Length	As required, in 1K (3,000 ft.) reels minimum
Connectors	As required by system design
Size	18 AWG, minimum, Outside 20 AWG, minimum, Inside
Color coding	Required, EIA industry standard
Bend radius	10X the cable outside diameter
Impedance	As required
Shield coverage	As required by OEM specification
Attenuation	
Frequency in MHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
50.0	52.0

2. Telephone:

- a. The System cable shall be provided by the Contractor to meet the minimum system requirements of Category Six service. The cable shall interconnect each part of the system. The cable shall be completely survivable in areas where it is installed.

b. Technical Characteristics:

Length	As required, in 1K (3,000 ft.) reels minimum
Cable	Voice grade category six
Connectors	As required by system design
Size	22 AWG, minimum, Outside 24 AWG, minimum, Inside
Color coding	Required, telephone industry standard
Bend radius	10X the cable outside diameter
Impedance	120 Ohms \pm 15%, BAL
Shield coverage	As required by OEM specification
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
62.0	52.0
100.0	68.0

3. Data Multi-Conductor:

- a. The cable shall be multi-conductor, shielded or unshielded cable with stranded conductors. The cable shall be able to handle the power and voltage used over the distance required. It shall meet Category Six service at a minimum.

b. Technical Characteristics:

Wire size	22 AWG, minimum
Working shield	350 V
Bend radius	10X the cable outside diameter
Impedance	100 Ohms \pm 15%, BAL
Bandwidth	100 mHz, minimum

DC RESISTANCE	10.0 Ohms/100M, maximum
Shield coverage	
Overall Outside (if OEM specified)	100%
Individual Pairs (if OEM specified)	100%
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
62.0	52.0
100.0	68.0

4. Fiber Optic:

a. Multimode Fiber:

- 1) The general purpose multimode fiber optic cable shall be a dual window type installed in conduit for all system locations. A load-bearing support braid shall surround the inner tube for strength during cable installation.
- 2) Technical Characteristics:

Bend radius	6.0", minimum Outer jacket, As required
FIBER DIAMETER	62.5 MICRONS
Cladding	125 microns
Attenuation	
850 nM	4.0 dB per kM, maximum
1,300 nM	2.0 dB per kM, maximum
Bandwidth	
850 nM	160 mHz, minimum
1,300 nM	500 mHz, minimum

Connectors	Stainless steel
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5. AC Power Cable: AC power cable(s) shall be 3-conductor, no. 12 AWG minimum, and rated for 13A-125V and 1,625W. Master AC power, installation specification and requirements, are given in the NEC and herein.

6. General Purpose Analog RF:

- a. The coaxial cable shall be an RG-6/U type (or equal), minimum and shall be increased in size (i.e. RG-11/U, .500", .750", etc.) as required to meet system design. It may also be used for baseband signals as approved by the OEM.
- b. Technical Characteristics:

Impedance	75 OHM, UNBAL
Center conductor 20 AWG, solid or stranded copper, or copper plated steel or aluminum	
Dielectric	Cellular polyethylene
Shield coverage	95%, copper braid
Connector type	BNC or UHF
Attenuation	
Frequency (k or mHz)	Maximum dB/30.5M (100ft.)
10 kHz	0.20
100 kHz	0.22
1.0 kHz	0.25
4.5 mHz	0.85
10.0 mHz	1.40
100 mHz	5.00 //

7. Public Address and/or General Purpose Audio:

- a. The audio cable shall be two-conductor, STP cable with stranded conductors. The cable shall be able to handle the power used for the load impedance over the distance required, with not more than 5% power loss. This cable is to be provided in local PA areas only and is not to be used as a part of the telephone system.
- b. Technical Characteristics:

Impedance	70.7VRMS audio signal
Wire size	20 AWG, minimum
Working shield	350 V
Color coding	Required, EIA audio industry standard
Connectors	As required
Bend radius	10X the cable outside diameter
Impedance	100 Ohms \pm 15%, BAL
Bandwidth	20 mHz, minimum
DC resistance	10.0 Ohms/100M (330 ft.), maximum
Shield coverage	
Overall Outside (if OEM specified)	100%
Individual Pairs (if OEM specified)	100%
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0

8. General Purpose Analog Video:

- a. The coaxial cable shall be an RG-59/U type (or equal), minimum.
It may also be used for baseband signals as approved by the OEM.
- b. Technical Characteristics:

Impedance	75 Ohm, UNBAL
Center conductor	20 AWG, SOLID OR STRANDED COPPER
Dielectric	Cellular polyethylene
Shield coverage	95%, copper braid
Connector type	BNC or UHF
Attenuation	
Frequency (k or mHz)	Maximum dB/30.5M (100ft.)
10 kHz	0.20
100 kHz	0.22

1.0 kHz	0.25
4.5 mHz	0.85
10.0 mHz	1.40
100 mHz	5.00

C. Outlet Connection Cables:

1. Telephone:

- a. The Contractor shall provide a connection cable for each TCO telephone jack in the System with 10% spares. The telephone connection cable shall connect the telephone instrument to the TCO telephone jack. The Contractor shall not provide telephone instrument(s) or equipment.

b. Technical Characteristics:

Length	1.8M (6ft.), minimum
Cable	Voice Grade
Connector	RJ-11/45 compatible male on each end
Size	24 AWG, minimum
Color coding	Required, telephone industry standard

2. Data:

- a. The Contractor shall provide a connection cable for each TCO data jack in the system with 10% spares. The data connection cable shall connect a data instrument to the TCO data jack. The Contractor shall not provide data terminal(s)/equipment.

b. Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Data grade Category Six
Connector	RJ-45 male on each end
Color coding	Required, data industry standard
Size	24 AWG, minimum

3. Fiber Optic:

- a. The Contractor shall provide a connection cable for each TCO fiber optic connector in the System with 10% spares. The data

connection cable shall connect a fiber optic instrument to the TCO fiber optic jack. The Contractor shall not provide fiber optic instrument(s)/equipment.

b. Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Flexible single conductor with jacket
Connector	ST male on each end
Size	To fit single mode or multimode cable//

4. Analog RF:

- a. The Contractor shall provide a connection cable for each TCO analog RF connector in the System with 10% spares. The analog RF connection cable shall connect a analog RF instrument to the TCO analog RF jack. The Contractor shall not provide analog RF equipment.

b. Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Flexible RG-6/U, minimum
Connector	"F" male on each end //

D. System Connectors:

1. Solderless (Forked Connector):

- a. The connector shall have a crimp-on coupling for quick connect/disconnect of wires or cables. The crimp-on connector shall be designed to fit the wire or cable furnished. The connector barrel shall be insulated and color-coded.

b. Technical Characteristics:

Impedance	As required
Working Voltage	500 V

2. Multipin:

- a. The connector shall have a crimp-on coupling for quick connect/disconnect of wires or cables. The crimp-on connector shall be designed to fit the wire or cable furnished. The

connector housing shall be fully enclosed and shielded. It shall be secured to the cable group by screw type compression sleeves.

b. Technical Characteristics:

Impedance	As required
Working Voltage	500 V
Number of pins	As requires, usually 25 pairs minimum

3. Modular (RJ-45/11 and RJ-45): The connectors shall be commercial types for voice and high speed data transmission applications. he connector shall be compatible with telephone instruments, computer terminals, and other type devices requiring linking through the modular telecommunications outlet to the System. The connector shall be compatible with UTP and STP cables.

a. Technical Characteristics:

Type	Number of Pins
RJ-11/45	Compatible with RJ45
RJ-45	Eight
Dielectric	Surge
Voltage	1,000V RMS, 60 Hz @ one minute, minimum
Current	2.2A RMS @ 30 Minutes or 7.0A RMS @ 5.0 seconds
Leakage	100 μ A, maximum
Connectability	
Initial contact resistance	20 mili-Ohms, maximum
Insulation displacement	10 mili-Ohms, maximum
Interface	Must interface with modular jacks from a variety of OEMs. RJ-11/45 plugs shall provide connection when used in RJ-45 jacks.
Durability	200 insertions/withdrawals, minimum

4. Fiber Optic: The connectors shall be commercial types for voice and high speed data transmission applications. The connector shall be compatible with telephone instruments, computer terminals, and other type devices requiring linking through the modular

telecommunications outlet to the system. The connector shall be compatible with UTP and STP cables.

5. "BNC" Type:

- a. The BNC connector shall have a bayonet locking coupling for quick connect/disconnect of coaxial cable/termination's. It shall be a crimp-on (twist on are acceptable) connector designed to fit the coaxial cable furnished.

b. Technical Characteristics:

Impedance	50 or 75 Ohms, UNBAL
Working Voltage	500 V //

6. "F" Type:

- a. The "F" connector shall have a screw type coupling for quick connect/disconnect of coaxial cable/termination's. It shall be a crimp-on connector designed to fit the coaxial cable furnished with integral 12.7 mm (½in.) ferrule.

b. Technical Characteristics:

Impedance	75 Ohms, UNBAL
Working Voltage	500 V //

E. Terminators:

1. Coaxial:

- a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on type that has low VSWR when installed and the proper impedance to terminate the required system unit or coaxial cable.

b. Technical Characteristics:

Frequency	0-1 GHz
Power blocking	As required
Return loss	25 dB
Connectors	"F", "BNC", minimum
Impedance	50 or 75 Ohms, UNBAL

2. Audio:

- a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on audio spade lug, twin plug, XL types that has low VSWR when installed and the proper impedance to terminate the required system unit or coaxial cable.
- b. Technical Characteristics:

Frequency	20-20 kHz, minimum
Power blocking	As required
Return loss	15 dB
Connectors	"Audio spade lug", "1/4", "1/8", "XL" or "RCA"
Impedance	
Bal	100 Ohms, minimum
Unbal	75 Ohm, minimum

3. Fiber Optic:

- a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on type that has low VSWR when installed and the proper impedance to terminate the required system unit or fiber optic cable.
- b. Technical Characteristics:

Frequency	Lightwave
Power blocking	As required
Return loss	25 dB
Connectors	"ST", minimum
Construction	Stainless steel
Impedance	As required

2.4 TELECOMMUNICATIONS CLOSET REQUIREMENTS

Refer to VA Handbook H-088C3, Telephone System Requirements, for specific TC guidelines for size, power input, security, and backboard mounting requirements. It is the Contractors responsibility to ensure TC compliance with the System Requirements.

2.5 ENVIRONMENTAL REQUIREMENTS

Technical submittals shall identify the environmental specifications for housing the system. These environmental specifications shall identify the requirements for initial and expanded system configurations for:

- A. Floor loading for batteries and cabinets.
- B. Minimum floor space and ceiling heights.
- C. Minimum size of doors for equipment passage.
- D. Power requirements: The bidders shall provide the specific voltage, amperage, phases, and quantities of circuits required.
- E. Air conditioning, heating, and humidity requirements. The bidder shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
- F. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).
- G. Proposed floor plan based on the expanded system configuration of the bidder's proposed EPBX for this Facility.
- H. Conduit size requirement (between equipment room and console room).

2.6 INSTALLATION KIT

The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the 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:

- A. System Grounding:
 - 1. The grounding kit shall include all cable and installation hardware required. All Telephone and Data equipment shall be connected to earth ground via internal building wiring, 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. Equipment Racks.
 - e. Equipment Cabinets.
 - f. Conduits.
 - g. Duct.
 - h. Cable Trays.
 - i. Power Panels.
 - j. Connector Panels.
 - k. Grounding Blocks.
- B. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
- C. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
- D. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
- E. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each subsystem according to the OEM requirements, as-installed drawings, and this document.
- F. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this document and explained herein.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Product Delivery, Storage and Handling:
- 1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment catalog numbers, model and serial identification numbers. The RE may inventory the cable, patch panels, and related equipment.

2. Storage and Handling: Store and protect equipment in a manner, which will preclude damage as directed by the RE.

B. System Installation:

1. After the contract's been awarded, and within the time period specified in the contract, the Contractor shall deliver the total system in a manner that fully complies with the requirements of this specification. The Contractor shall make no substitutions or changes in the System without written approval from the RE and PM.
2. The Contractor shall install all equipment and systems in a manner that complies with accepted industry standards of good practice, OEM instructions, the requirements of this specification, and in a manner which does not constitute a safety hazard. The Contractor shall insure that all installation personnel understands and complies with all the requirements of this specification.
3. The Contractor shall install suitable filters, traps, directional couplers, splitters, TC's, and pads for minimizing interference and for balancing the System. Items used for balancing and minimizing interference shall be able to pass telephone and data, and lightwave, and analog signals in the frequency bands selected, in the direction specified, with low loss, and high isolation, and with minimal delay of specified frequencies and signals. The Contractor shall provide all equipment necessary to meet the requirements of Paragraph 2.1.C and the System performance standards.
4. All passive equipment shall be connected according to the OEM's specifications to insure future correct termination, isolation, impedance match, and signal level balance at each telephone/data outlet.
5. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
6. All lines shall be terminated in a suitable manner to facilitate future expansion of the System. There shall be a minimum of one spare 25 pair cable at each distribution point on each floor.
7. All vertical and horizontal copper and fiber optic and coaxial cables shall be terminated so any future changes only requires modifications of the existing EPBX or signal closet equipment only.
8. Terminating resistors or devices shall be used to terminate all unused branches, outlets, equipment ports of the System, and shall be devices designed for the purpose of terminating fiber optic or

twisted pair and coaxial , and lightwave cables carrying telephone and data , and analog signals in telephone and data, and analog video and lightwave systems.

9. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks with two keys.

C. Conduit and Signal Ducts:

1. Conduit:

- a. The Contractor shall employ the latest installation practices and materials. The Contractor shall provide conduit, junction boxes, connectors, sleeves, weatherheads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc., shall be sleeved and sealed. The minimum conduit size shall be 19 mm (3/4 in.).
- b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow telephone cables and data cables to be installed open supported to building structure per requirements of the NEC.) 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 16111, CONDUIT SYSTEMS, and the NEC.
- d. When "innerduct" flexible cable protective systems is specifically authorized to be provided for use in the System, it's installation guidelines and standards shall be as the specified herein, SECTION 16111, CONDUIT SYSTEMS, and the NEC.
- e. Conduit (including GFE) fill shall not exceed 40%. Each conduit end shall be equipped with a protective insulator or sleeve to cover the conduit end, connection nut or clamp, to protect the wire or cable during installation and remaining in the conduit. Electrical power conduit shall be installed in accordance with the NEC. AC power conduit shall be run separate from signal conduit.

- f. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, SECTION 16111, CONDUIT SYSTEMS, and the NEC.
 - g. Ensure that Critical Care Nurse Call, PA, and Radio Paging Systems (as identified by NEC Section 517) are completely separated and protected from all other systems.
 - 2. Signal Duct, Cable Duct, or Cable Tray:
 - a. The Contractor shall use existing 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. Distribution System Signal Wires and Cables:
- 1. Wires and cables shall be provided in the same manner and use like construction practices as Fire Protective and other Emergency Systems that are identified and outlined in NFPA 101, Life Safety Code, Chapters 7, 12, and/or 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions. The wires and cables shall be able to withstand adverse environmental conditions in their respective location without deterioration. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
 - a. Each wire and cable shall terminate on an item of equipment by direct connection. Spare or unused wire and cable shall be provided with appropriate connectors (female types) that are installed in appropriate punch blocks, barrier strips, patch, or bulkhead connector panels.

- b. Fiber optic cables that are spare, unused or dark shall be provided with Industry Standard "ST" type female connectors installed in appropriate break out, patch, or bulkhead connector panels provided in enclosure(s) and shall be protected from the environment.
 - c. All cable junctions and taps shall be accessible. Provide an 8" X 8" X 4" (minimum) junction box attached to the cable duct or raceway for installation of distribution system passive equipment. Ensure all equipment and tap junctions are accessible.
2. Routing and Interconnection:
- a. Wires or cables between consoles, cabinets, racks and other equipment shall be in an approved conduit, signal duct, cable duct, or cable tray that is secured to building structure.
 - b. Wires and cables shall be insulated to prevent contact with signal or current carrying conductors. Wires or cables used in assembling consoles, panels, equipment cabinets and racks shall be formed into harnesses that are bundled and tied. Harnessed wires or cables shall be combed straight, formed and dressed in either a vertical or horizontal relationship to equipment, controls, components or terminations.
 - c. Harnesses with intertwined members are not acceptable. Each wire or cable that breaks out from a harness for connection or termination shall have been tied off at that harness or bundle point, and be provided with a neatly formed service loop.
 - d. Wires and cables shall be grouped according to service (i.e.: AC, grounds, signal, DC, control, etc.). DC, control and signal cables may be included with any group. Wires and cables shall be neatly formed and shall not change position in the group throughout the conduit run. Wires and cables in approved signal duct, conduit, cable ducts, or cable trays shall be neatly formed, bundled, tied off in 600 mm to 900 mm (24 in. to 36 in.) lengths and shall not change position in the group throughout the run. Concealed splices are not allowed.
 - e. Separate, organize, bundle, and route wires or cables to restrict EMI, channel crosstalk, or feedback oscillation inside any enclosure. Looking at any enclosure from the rear (wall mounted enclosures, junction, pull or interface boxes from the front), locate AC power, DC and speaker wires or cables on the left;

coaxial, control, microphone and line level audio and data wires or cables, on the right. This installation shall be accomplished with ties and/or fasteners that will not damage or distort the wires or cables. Limit spacing between tied off points to a maximum of 150 mm (6 inches).

- f. Do not pull wire or cable through any box, fitting or enclosure where change of cable tray or signal or cable duct alignment or direction occurs. Ensure the proper bend radius is maintained for each wire or cable as specified by it's OEM.
- g. Employ temporary guides, sheaves, rollers, and other necessary items to protect the wire or cable from excess tension or damage from bending during installation. Abrasion to wire or cable jackets is not acceptable and will not be allowed. Replace all cables whose jacket has been abraded. The discovery of any abraded and/or damaged cables during the proof of performance test shall be grounds for declaring the entire system unacceptable and the termination of the proof of performance test. Completely cover edges of wire or cable passing through holes in chassis, cabinets or racks, enclosures, pull or junction boxes, conduit, etc., with plastic or nylon grommeting.
- h. Cable runs shall be splice free between conduit junction and interface boxes and equipment locations.
- i. Cables shall be installed and fastened without causing sharp bends or rubbing of the cables against sharp edges. Cables shall be fastened with hardware that will not damage or distort them.
- j. Cables shall be labeled with permanent markers at the terminals of the electronic and passive equipment and at each junction point in the System. The lettering on the cables shall correspond with the lettering on the record diagrams.
- k. Completely test all of the cables after installation and replace any defective cables.
- l. Wires or cables that are installed outside of buildings shall be in conduit or secured to solid building structures. If 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.

m. Wires or cables installed outside of conduit, cable trays, wireways, cable duct, etc.

- 1) Where demonstrated on the plan and as described herein, wires or cables are 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.
- 2) Wires and cables shall be hidden, protected, fastened and tied at 600 mm (24 in.) intervals, maximum, as described herein to building structure.
- 3) Closer wire or cable fastening intervals 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.
- 4) 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. Outlet Boxes, Back Boxes, and Faceplates:

1. Outlet Boxes: Signal, power, interface, connection, distribution, and junction boxes shall be provided as required by the system design, on-site inspection, and review of the contract drawings.
2. Back Boxes: Back boxes shall be provided as directed by the OEM as required by the approved system design, on-site inspection, and review of the contract drawings.
3. Face Plates (or Cover Plates): Faceplates shall be of a standard type, stainless steel, anodized aluminum or UL approved cycloc plastic construction and provided by the Contractor for each identified system outlet location. Connectors and jacks appearing on the faceplate shall be clearly and permanently marked.

F. Connectors: Circuits, transmission lines, and signal extensions shall have continuity, correct connection and polarity. A uniform polarity shall be maintained between all points in the system.

1. Wires:
 - a. Wire ends shall be neatly formed and where insulation has been cut, heat shrink tubing shall be employed to secure the insulation on each wire. Tape of any type is not acceptable.
 - b. Audio spade lugs shall be installed on each wire (including spare or unused) end and connect to screw terminals of appropriate size barrier strips. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current. Punch blocks are approved for signal, not AC wires. Wire Nut or "Scotch Lock" connectors are not acceptable for signal wire installation.
2. Cables: Each connector shall be designed for the specific size cable being used and installed with the OEM's approved installation tool. Typical system cable connectors include; but, are not limited to: Audio spade lug, punch block, wirewrap, etc.
3. Line or Microphone Audio: Each connector shall be installed according to the cable or connector OEM's instructions and use the OEM's approved installation tool. Install the connector's to provide and maintain the following audio signal polarity:
 - a. XLR type connectors Signal or positive conductor is pin 3; common or neutral conductor is pin 2; ground conductor is pin 1.
 - b. Two and 3 conductor 1/4" Signal or positive conductor is tip; neutral or 1/8" phono plugs conductor is ring and ground or shield and jacks conductor is sleeve.
 - c. RCA Phono Plugs the Signal or positive conductor is tip; and Jacks neutral or shield conductor is sleeve.
4. Speaker Line Audio:
 - a. Each connector shall be installed according to the cable, transformer or speaker OEM instructions and using the OEM's approved installation tool. The Contractor shall ensure each speaker is properly phased and connected in the same manner throughout the System using two conductor type wires.
 - b. One of the conductors shall be color coded to aid in establishing speaker signal polarity. Each speaker line shall be permanently soldered or audio spade lug connected to each appropriate speaker or line matching transformer connection terminal. Speaker line connection to each audio amplifier shall use audio spade lugs, as described herein.

G. AC Power: AC power wiring shall be run separately from signal cable.

H. Grounding:

1. General: The Contractor shall ground all Contractor Installed Equipment and identified Government Furnished Equipment to eliminate all shock hazards and to minimize, to the maximum extent possible, all ground loops, common mode returns, noise pickup, crosstalk, etc. The total ground resistance shall be 0.1 Ohm or less.
 - a. The Contractor shall install lightning arrestors and grounding in accordance with the NFPA and this specification.
 - b. Gas protection devices shall be provided on all circuits and cable pairs serving building distribution frames located in buildings other than the building in which the is located or in any area served by an unprotected distribution system (manhole, aerial, etc.). The Contractor shall install the gas protection devices at the nearest point of entrance in buildings where protection is required and on the same circuits on the MDF in the telephone switch room.
 - c. Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, subcarrier or audio reference ground.
 - d. The use of conduit, signal duct or cable trays as system or electrical ground is not acceptable and will not be permitted. These items may be used only for the dissipation of internally generated static charges (not to be confused with externally generated lightning) that may applied or generated outside the mechanical and/or physical confines of the System to earth ground. The discovery of improper system grounding shall be grounds to declare the System unacceptable and the termination of all system acceptance testing.
2. Cabinet Buss: A common ground buss of at least #6 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground. Provide a separate isolated ground connection from each equipment cabinet ground buss to the system ground. Do not tie equipment ground busses together.
3. Equipment: Equipment shall be bonded to the cabinet bus with copper braid equivalent to at least #12 AWG. Self grounding equipment enclosures, racks or cabinets, that provide OEM certified functional

ground connections through physical contact with installed equipment, are acceptable alternates.

4. Cable Shields: Cable shields shall be bonded to the cabinet ground buss with #12 AWG minimum stranded copper wire at only one end of the cable run. Cable shields shall be insulated from each other, faceplates, equipment racks, consoles, enclosures or cabinets; except, at the system common ground point. Coaxial and audio cables, shall have one ground connection at the source; in all cases, cable shield ground connections shall be kept to a minimum.

I. Equipment Assembly(Existing Provided during Phase 1):

1. Cabinets:

- a. Each enclosure shall be: floor or wall mounted with standard knockout holes for conduit connections or cable entrance; provide for ventilation of the equipment; have front and rear locking doors (except wall mounted cabinets that require only a front locking door); power outlet strip(s), and connector or patch panel(s).
- b. Rack (including freestanding radio relay) mounted equipment shall be installed in the enclosure's equipment adjustable mounting racks with equipment normally requiring adjustment or observation mounted so operational adjustment(s) can be conveniently made. Heavy equipment shall be mounted with rack slides or rails allowing servicing from the front of the enclosure. Heavy equipment shall not depend only upon front panel mounting screws for support. Equipment shall be provided with sufficient cable slack to permit servicing by removal of the installed equipment from the front of the enclosure. A color matched blank panel (spacer) of 44 mm (1.75 in.) high, shall be installed between each piece of equipment (active or passive) to insure adequate air circulation. The enclosure shall be designed for efficient equipment cooling and air ventilation. Each console or cabinet shall be equipped with a quiet fan and nondisposable air filter.
- c. Enclosures and racks shall be installed plumb and square. Each shall be permanently attached to the building structure and held firmly in place. Fifteen inches of front vertical space opening shall be provided for additional equipment.
- d. Signal connector, patch, and bulkhead panels (i.e.: audio, data, control, analog video, etc.) shall be connected so that outputs

from each source, device or system component shall enter the panel at the top row of jacks, beginning left to right as viewed from the front, which will be called "inputs". Each connection to a load, device or system component shall exit the panel at the bottom row of jacks, beginning left to right as viewed from the front, which will be called "outputs".

- 1) Equipment located indoors shall be installed in metal racks or enclosures with hinged doors to allow access for maintenance without causing interference to other nearby equipment.
- 2) Cables shall enter the equipment racks or enclosures in such a manner that allows all doors or access panels to open and close without disturbing or damaging the cables.
- 3) All distribution hardware shall be securely mounted in a manner that allows access to the connections for testing and provides sufficient room for the doors or access panels to open and close without disturbing the cables.

J. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for voice and data circuits shall be stenciled using // laser printers thermal ink transfer process. Handwritten labels are not acceptable.

1. Cable and Wires (Hereinafter referred to as "Cable"): Cables shall be labeled at both ends in accordance with ANSI/EIA/TIA-606-A. Labels shall be permanent in contrasting colors. Cables shall be identified according to the System "Record Wiring Diagrams".
2. Equipment: System equipment shall be permanently labeled with contrasting plastic laminate or bakelite material. System equipment shall be labeled on the face of the unit corresponding to its source.
3. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying it as the System. In addition, each enclosure shall be labeled according to this standard.
4. Termination Hardware: The Contractor shall label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with ANSI/EIA/TIA-606-A and the "Record Wiring Diagrams".

3.2 TESTS

A. Interim Inspection:

1. This inspection shall verify that the equipment provided adheres to the installation requirements of this document. The interim inspection will be conducted by a factory-certified representative and witnessed by a Government Representative. Each item of installed equipment shall be checked to insure appropriate UL certification markings. This inspection shall verify cabling terminations in telecommunications rooms and at workstations adhere to color code for T568B, T568A pin assignments and cabling connections are in compliance with ANSI/EIA/TIA standards. Visually confirm Category 6 marking of outlets, faceplates, outlet/connectors and patch cords.
2. Perform fiber optical field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
3. The Contractor shall notify the RE, in writing, of the estimated date the Contractor expects to be ready for the interim inspection, at least 20 working days before the requested inspection date.
4. Results of the interim inspection shall be provided to the RE and PM. If major or multiple deficiencies are discovered, a second interim inspection may be required before permitting the Contractor to continue with the system installation.
5. The RE and/or the PM shall determine if an additional inspection is required, or if the Contractor will be allowed to proceed with the installation. In either case, re-inspection of the deficiencies noted during the interim inspection(s), will be part of the proof of performance test. The interim inspection shall not affect the Systems' completion date. The Contracting Officer shall ensure all test documents will become a part of the Systems record documentation.

B. Pretesting:

1. Upon completing the installation of the System, the Contractor shall align and balance the system. The Contractor shall pretest the entire system.
2. Pretesting Procedure:
 - a. During the system pretest, the Contractor shall verify (utilizing the approved spectrum analyzer and test equipment) that the

System is fully operational and meets all the system performance requirements of this standard.

- b. The Contractor shall pretest and verify that all System functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. The Contractor shall measure and record the aural carrier levels of each system telephone and data channel, at each of the following points in the system:
 - 1) Local Telephone Company Interfaces or Inputs.
 - 2) EPBX interfaces or inputs and outputs.
 - 3) MDF interfaces or inputs and outputs.
 - 4) EPBX output S/NR for each telephone and data channel.
 - 5) Signal Level at each interface point to the distribution system, the last outlet on each trunk line plus all outlets installed as part of this contract.
 3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.
- C. Acceptance Test:
1. After the System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 30 days written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of a Government Representative and an OEM certified representative. The System shall be tested utilizing the approved test equipment to certify proof of performance and Life Safety compliance. The test shall verify that the total System meets the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
- D. Verification Tests:
1. Test the UTP, STP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has an overall shield. Test the operation of shorting bars in connection blocks. Test cables after termination and prior to cross-connection.

2. Multimode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with ANSI/EIA/TIA-568-B.3 and ANSI/EIA/TIA-526-14A using Method A, Optical Power Meter and Light Source and/or Method B, OTDR. Perform verification acceptance test.
3. Single mode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with ANSI/EIA/TIA-568-B.3 and ANSI/EIA/TIA-526-7 using Method A, Optical Power Meter and Light Source and/or Method B, OTDR. Perform verification acceptance test.

E. Performance Testing:

1. Perform Category 6 tests in accordance with ANSI/EIA/TIA-568-B.1 and ANSI/EIA/TIA-568-B.2. Test shall include the following: wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.
2. Fiber Optic Links: Perform end-to-end fiber optic cable link tests in accordance with ANSI/EIA/TIA-568-B.3.

F. Total System Acceptance Test: The Contractor shall perform verification tests for UTP, STP copper cabling system(s) and the multimode fiber optic cabling system(s) after the complete telecommunication distribution system and workstation outlet are installed.

1. Voice Testing: Connect to the network interface device at the demarcation point. Go off-hook and receive dial tone from the LEC. If a test number is available, place and receive a local, long distance, and FTS telephone call.
2. Data Testing: Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network is achieved.

3.3 TRAINING

- A. Furnish the services of a factory-trained engineer or technician for a total of two four hour classes to instruct designated Facility IRM personnel. Instruction shall include cross connection, corrective, and preventive maintenance of the System and equipment.
- B. Before the System can be accepted by the VA, this training must be accomplished. Training will be scheduled at the convenience of the Facilities Contracting Officer and Chief of Engineering Service.

3.4 GUARANTEE PERIOD OF SERVICE

- A. Contractor's Responsibilities:
 1. The Contractor shall guarantee that all installed material and equipment will be free from defects, workmanship, and will remain so

- for a period of one year from date of final acceptance of the System by the VA. The Contractor shall provide OEM's equipment warranty documents, to the RE (or Facility Contracting Officer if the Facility has taken possession of the building(s)), that certifies each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. The Contractor and OEM shall provide this contact capability at no additional cost to the VA.
 3. All Contractor installation, maintenance, and supervisor personnel shall be fully qualified by the OEM and 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 one year guarantee period:
 - a. Response Time:
 - 1) The RE (or facility Contracting Officer if the facility has taken possession of the building[s]) are the Contractor's reporting and contact officials for the System trouble calls, during the guarantee period.
 - 2) A standard workweek is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal Holidays.
 - 3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
 - a) A routine trouble call within one working days of its report. A routine trouble is considered a trouble which causes a system outlet, station, or patch cord to be inoperable.
 - b) An emergency trouble call within 6 hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point to be inoperable at anytime. Additionally, the loss of a minimum of 50 station or system lines shall be deemed as this type of a trouble call.

- 4) The Contractor shall respond on-site to a catastrophic trouble call within 4 hours of its report. A catastrophic trouble call is considered total system failure.
 - a) If a system failure cannot be corrected within four hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate system CSS or TCO equipment, or cables. The alternate equipment and/or cables shall be operational within four hours after the four hour trouble shooting time.
 - b) Routine or emergency trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as a catastrophic trouble call if so determined by the RE or Facility Director. The RE or Facility Contracting Officer shall notify the Contractor of this type of trouble call at the direction of the Facilities Director.
- b. Required on-site visits during the one year guarantee period
 - 1) The Contractor shall visit, on-site, for a minimum of eight hours, once every 12 weeks, during the guarantee period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this SPEC.
 - a) The Contractor shall arrange all Facility visits with the RE or Facility Contracting Officer prior to performing the required maintenance visits.
 - b) The Contractor in accordance with the OEM's recommended practice and service intervals shall perform preventive maintenance during a non-busy time agreed to by the RE or Facility Contracting Officer and the Contractor.
 - c) The preventive maintenance schedule, functions and reports shall be provided to and approved by the RE or Facility Contracting Officer.
 - 2) 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 Total System Acceptance Test. The following reports are the minimum required:

a) Monthly Report: The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to RE or Facilities Contracting Officer by the fifth working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and Systems for preventive and predictive maintenance

b) Contractor Log: The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the System. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.

3) The RE or Facility Contracting Officer shall provide the Facility Engineering Officer, two (2) copies of actual reports for evaluation.

a) The RE or Facility Contracting Officer shall ensure copies of these reports are entered into the System's official acquisition documents.

b) The Facilities Chief Engineer shall ensure copies of these reports are entered into the System's official technical as-installed documents.

B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use, accidents, other vendor, contractor, owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the 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 findings concerning any Contractor's responsibility.

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SECTION 27 41 31
MASTER ANTENNA TELEVISION EQUIPMENT AND SYSTEMS

PART 1 - GENERAL

1.1 SECTION SUMMARY

- A. Work covered by this document includes design, engineering, labor, material, products, guarantee, training and services for, and incidental to, the installation of new and fully operating National Cable Television Association (NCTA) Listed and Society of Cable Telecommunications Engineers (SCTE) Certified Master Antenna Television (TV) equipment and systems as detailed herein.
- B. Work shall be complete, complete, labeled, VA Central Office (VACO) tested and certified and ready for operation
- C. This section specifies the furnishing, installing and testing of a complete and operating extension of an existing Master Antenna TV System, and associated equipment. The system shall include but not be limited to: interface cabinet; necessary combiners and filters; distribution amplifiers; cable and connectors; and necessary passive devices such as splitters, directional couplers, TV outlets and taps.
- D. The Extension of the Master Antenna TV (MATV) system shall be delivered free of engineering, manufacturing, installation and operating defects. The system shall be engineered and installed for ease of operation, maintenance and testing.
- E. The MATV Extension system shall receive the VHF and converted UHF TV channel signals from the existing MATV System (Direct TV) and shall process and distribute them to the designated TV outlets indicated on the drawings.
- F. The MATV Extension system shall provide adjacent channel operation of the 89 television channels minimum.
- G. The MATV Extension system shall provide for connection of HD CATV capable TV receivers to the designated TV outlets in all rooms as shown on the drawings.
- H. A MATV Extension system design where looping the RF cable from room to room shall not be permitted.
- I. The signals shall be acquired at the existing MATV head-end equipment cabinet, or as close to the MATV head-end equipment cabinet as possible. The Contractor is not responsible for the condition of the signals of the existing MATV system. However, the Contractor is required to optimize the TV signals without compromising the existing

MATV system. If trouble is found in the exiting system, the Contractor shall notify the Resident Engineer in writing of the nature of troubles, and the expected effect on the signals in the extension system.

1.2 RELATED SECTIONS

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 Volts and Below).
- C. Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- D. Section 27 10 00, STRUCTURED COMMUNICATIONS SYSTEMS CABLING.
- E. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- F. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- G. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- H. Section 27 10 00, STRUCTURED CABLING.
- I. Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
- J. Section 01 00 00, GENERAL REQUIREMENTS

1.3 DEFINITIONS

- A. Provide: Design, engineer, furnish, install, connect complete, test, certify and guarantee.
- 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/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

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/Codes:

a. Departments of:

1) CFR, Title 15 - Department of Commerce, 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 Federal communications Commission (FCC) Title 47 (CFR), Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions and Locations.

2) CFR, Title 29, Department of Labor, Chapter XVII - Occupational Safety and Health Administration (OSHA), Part 1910 - Occupational Safety and Health Standard:

a) Subpart 7 - Definition and requirements for a National Recognized Testing Laboratory (NRTL - 15 Laboratory's, for complete list, contact

http://www.osha.gov/dts/otpc/nrtl/faq_nrtl.html)

(1) Underwriter's Laboratories (UL):

65	Standard for Wired Cabinets.
468	Standard for Grounding and Bonding Equipment.
1449	Standard for Transient Voltage Surge Suppressors.
1069	Hospital Signaling and Nurse Call Equipment.
60950-1/2	Information Technology Equipment - Safety.

(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.
- 3) Public Law No. 100-527, Department of Veterans Affairs:
- a) Office of Telecommunications: Handbook 6100 - Telecommunications.
 - 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) Spectrum Management FCC and NTIA Radio Frequency Compliance and Licensing Program.
 - d) 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.
- 4) Title 42, CFC, Department of Health, Chapter IV Health and Human Services, Subpart 1395(a)(b) Joint Commission on Accreditation of Healthcare Organizations (JCAHO) "a hospital that meets JCAHO accreditation is deemed to meet the Medicare conditions of Participation by meeting Federal Directives:" All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.
- 5) CFR, Title 47 - Telecommunications, in addition to FCC: 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):

Part 73	Radio Broadcast Service,
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Part 90	Rules and Regulations, Appendix C.
Form 854	Antenna Structure Registration.

- 6) Public Law 89-670, Department of Transportation, CFR-49, Part 1, Subpart C - Federal Aviation Administration (FAA):
- a) Standards AC 110/460-ID and AC 707/460-2E - Advisory Circulars for Constructions of Antenna Towers.
 - b) Forms 7450 and 7460-2 - Antenna Construction Registration.

2. 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):

568-B	Commercial Building Telecommunications Wiring Standards:
569	Commercial Building Standard for Telecommunications Pathways and Spaces.
606	Administration Standard for the Telecommunications Infrastructure of Communications Buildings.
607	Commercial Building Grounding and Bonding Requirements for Telecommunications.
REC 127-49	Power Supplies.
RS 27	Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.

- c. Institute of Electrical and Electronics Engineers (IEEE):

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.
0739- 5175/08/\$25.	Medical Grade - Mission Critical - Wireless Networks.

00@2008IEEE	
C62.41	Surge Voltages in Low-Voltage AC Power Circuits.

- d. American Society of Mechanical Engineers (ASME):
- 1) Standard 17.4, Guide for Emergency Personnel.
 - 2) Standard 17.5, Elevator and Escalator Equipment (prohibition of installing non-elevator equipment in Elevator Equipment Room/Mechanical Penthouse).
- e. NFPA:

70	National Electrical Code (current date of issue) - Articles 517, 645 and 800.
75	Standard for Protection of Electronic Computer Data- Processing Equipment.
77	Recommended Practice on Static Electricity.
99	Healthcare Facilities.
101	Life Safety Code.

3. State Hospital Code(s).

4. Local Codes.

1.5 QUALIFICATIONS

- A. The OEM shall have had experience with three or more installations of systems of comparable size and complexity about type and design as specified herein. Each of these installations shall have performed satisfactorily for at least 1 year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.
- B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of 3 years. The Contractor shall be authorized by the OEM to pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the system. This documentation, along with the System Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.
- C. The Contractor's Communications Technicians assigned to the system shall be fully trained, qualified, and certified by the OEM on the

engineering, installation, operation, and testing of the system. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the Resident Engineer before being allowed to commence work on the system.

- D. Applicable national, state and local licenses.
- E. Certificate of successful completion of OEM's installation/training school for installing technicians of the equipment being proposed.

1.6 CODES AND PERMITS

- 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.

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

- 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-0050P3B - herein after referred to as [0050P3B]) will not review any submittal that does not have this list.
- D. Provide 4 copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C and D, at a minimum for compliance review as described herein where each responsible individual(s) should respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).
- E. Head End and each interface distribution cabinet layout drawing, as they are to be installed.
- F. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
- H. Engineering drawings of the system, showing calculated signal levels at the Head End input and output, each input and output distribution point, and signal level at each MATV outlet. A detailed and calculated single line diagram demonstrating all directional couplers, splitters, and MATV outlets shall be provided. Calculations shall be provided at 550 MHz providing Minimum +5dB and Maximum +10dB output at each outlet tap. Calculations shall be based on a homerun system distribution.

1.9 PROJECT RECORD DOCUMENTS (AS BUILTS)

- A. Throughout progress of the work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
- B. The floor plans shall be marked in pen to include the following:
 - 1. All device locations with labels.
 - 2. Conduit locations.
 - 3. Head-end equipment and specific location.
 - 4. Wiring diagram.
 - 5. Labeling and administration documentation.
 - 6. Warranty certificate.
 - 7. System test results.

1.10 WARRANTIES AND GUARANTEE

- A. The Contractor shall warrant the installation be free from defect in material and workmanship for a period of 1 year from the date of acceptance of the project by the owner. The Contractor shall agree to

remedy covered defects within eight (8) hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.

B. Refer to Part 4 for applicable System Guarantee requirements.

1.11 USE OF THE SITE

A. Use of the site shall be at the GC's direction.

B. Coordinate with the GC for lay-down areas for product storage and administration areas.

C. Coordinate work with the GC and their sub-contractors.

D. Access to buildings wherein the work is performed shall be directed by the GC.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.

B. Store products in original containers.

C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.

D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

1.13 PROJECT CLOSEOUT

A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.

B. Before the project closeout date, the Contractor shall submit:

1. Warranty certificate.

2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.

3. Project record documents.

4. Instruction manuals and software that is a part of the system.

C. Contractor shall submit written notice that:

1. Contract Documents have been reviewed.

2. Project has been inspected for compliance with contract.

3. Work has been completed in accordance with the contract

PART 2 - PRODUCTS AND FUNCTIONAL REQUIREMENTS

2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

- A. Furnish and install a complete and fully operational extension to the existing master antenna TV signal distribution system. Include all splitters, directional couplers, cables, outlets, attenuators, antennas, and all other parts necessary for the reception and distribution of the off-the-air TV signals.
- B. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- C. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.
- D. Distribute cable channels to all TV outlets to permit simple connection of EIA standard high definition television (HDTV) receivers.
- E. Deliver at all outlets all HDTV monochrome and color television signals without introducing noticeable effect on picture and color fidelity or sound. System picture fidelity shall be equal to that received from the cable company and other modulated channels.
- F. Provide reception quality at each outlet equal to or better than that received in the area with individual antennas. Deliver at all television outlets a minimum +5.0 dBmv (2,000 microvolts across 75 Ohms) and maximum of +10 dBmv (20,000 microvolts) for each channel at each outlet. Measure At 550 Mhz.
- G. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.
- H. Meet all FCC requirements regarding low radiation and/or interference of RF signal(s). The system shall be designed to prevent direct pickup of signals from the building structure.
- I. Weather-Resistant Equipment: Listed and labeled by an OSHA certified National Recognized Testing Laboratory (NRTL - i.e. UL) for duty outdoors or in damp locations.

2.2 SYSTEM DESCRIPTION

- A. The Contractor shall continually employ interfacing methods that are approved by the OEM and VA. At a minimum, an acceptable interfacing method requires not only a physical and mechanical connection, but also a matching of signal, voltage, and processing levels with regard to

signal quality and impedance. The interface point must adhere to all standards described herein for the full separation of Critical Care and Life Safety systems.

- B. It is not acceptable to utilize the telephone cable system for the control of MATV signals and equipment. The System Contractor shall connect the system ensuring that all NFPA and Underwriters Laboratory, Inc. (UL) Critical Care and Life Safety Circuit and system separation guidelines are satisfied. The System Contractor is not allowed to make any connections to the Telephone System. The Owner shall arrange for the interconnection between the MATV and the Nurses Call System with the appropriate responsible parties.
- C. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications and be provided with screw type audio connectors.
- D. 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.
- E. The system shall utilize microprocessor components for all signaling and programming circuits and functions. System program memory shall be non-volatile or protected from erasure from power outages for a minimum of 30 minutes.
- F. 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.
- G. All equipment faceplates utilized in the system shall be stainless steel, anodized aluminum or UL approved cycolac plastic for the areas where provided.
- H. Noise filters and surge protectors shall be provided for each equipment interface cabinet, Head End cabinet, control console and local and remote ampler locations to insure protection from input primary AC

power surges and to insure noise glitches are not induced into low voltage data circuits.

- I. Audio Level Processing: The use of telephone cable to distribute MATV 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 TV/speaker identified on the contract drawings.
- J. 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 based on the outlets indicated on the drawings. Additional components required to provide a complete and operable extension of the existing MATV system shall be provided to extend all functions and channels into the project area.

2.3 MANUFACTURERS

- A. The products specified shall be new, FCC and UL Listed, and produced by OEM manufacturer 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.
- 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. The equipment items are the salient requirements of VA to provide an acceptable system described herein.

2.4 PRODUCTS

- A. Connect to the Existing distribution amplifier (provided during Phase 1) with a frequency range of 49-1,000 MHz and shall accommodate a minimum of 35 HDTV channels of programming. Gain of the preamplifier shall be 32dB, with an output level of 48dBmV for each HDTV channel processed. The preamplifier shall utilize a hybrid push-pull amplifier module. The preamplifier shall provide gain and slope control ranges of 8dB and 9dB, respectively.
- B. Provide as necessary 8-port passive combiner for the combining of all RF signals into one main trunk run for distribution to all building locations. Bandwidth of combiners shall be 0 to 1,000MHz.
- C. Provide riser rated coaxial cable with a nominal characteristic impedance of 75 Ohms throughout the entire frequency spectrum utilized in this system. Each reel of cable shall be sweep-tested and return-loss tested over the entire frequency range from 50MHz to 750MHz by the manufacturer. Provide RG-6, RG-11 or appropriate minimum .500" Hardline Coaxial cable as required to achieve the specified signal level. However, all runs over 150' in length shall be RG-11 or .500".
- D. Line Splitters:
 - 1. Provide low-radiation line splitters with a flat frequency response from 50MHz to 1,000MHz. Provide units of a hybrid design with a 75-ohm match on input and outputs and a VSWR no greater than 1.4:1.
 - 2. Two way line splitters shall have a signal loss of not more than 3.5dB at each output.
 - 3. Four way line splitters shall have a signal loss of not more than 7.2dB at each output.
 - 4. All unused splitter outputs shall be terminated with 75-Ohm terminations.
- E. MATV/HDTV Outlets:
 - 1. Provide outlets at each location shown on the plans. Mount in electrical contractor provided 4" square with 1-gang ring, 2" deep minimum flush electrical boxes as indicated on plans.
 - 2. Provisions shall be incorporated in the network to prevent 60 Hz AC or DC feedback into the distribution lines.
 - 3. Outlets shall be designed to cover a frequency range of 10MHz to 1,000MHz. Insertion loss shall not exceed 1.0 db at any frequency within the designated frequency range for a 17dB isolation network. Outlets shall be back-matched from 10 to 1,000MHz. Outlets shall

- have one F-type connector on the front and two F-type connectors on the rear.
4. The minimum isolation value between any two outlets shall be 24 db.
 5. Provide provision for pillow speaker remote control on the outlet tap frame as an integrated component.
- F. Television Receivers shall be provided separately by the Owner.
- G. Distribution Devices:
1. Distribution Amplifier:
 - a. Description: Broadband CATV quality HDTV distribution amplifier.
 - b. Specifications:

Frequency Range: 49MHz to 1,000MHz.	Channel Loading: 150.
Flatness: +/- .75dB.	Gain: 42dB.
Output Level: +40dBmV.	Gain Control Range: 10dB.
Slope Control Range: 8dB.	Plug in equalizers as needed.
Attenuator options as needed.	

2. Splitters:
 - a. Description: RF signal splitter.
 - b. Specifications:

Frequency Range: 5MHz to 1,000MHz.	Outputs: 2, 3, 4 and 8.
Splitter Loss: less than 12 dB.	RFI Shielding: 120dB.

3. Taps:
 - a. Description: Directional Coupler Type Taps.
 - b. For use in Telecomm closets or accessible cable trays.
 - c. Specifications:
 1. Frequency Range: 5MHz to 1,000MHz.
 2. Outputs: 2, 4 and 8.
 3. Isolation Tap Value: Varies.
4. Wallplate Bulkhead Connector and Terminators:
 - a. Description: Wall plates for termination of MATV/CATV signals at television sets.
 1. Impedance: 75 Ohms.
 2. Frequency Band: SUB/VHF/CATV/UHF.

3. Multi-pin Jack for remote control. Coordinate with the Television input for pillow speaker remote control if necessary.

5. "F" Connectors:

- a. Coaxial cable connectors and connector inserts shall be designed to provide maximum performance with the cable to be used. Coaxial cables shall be connectorized with the Head End quality 360 degree F connectors as applicable, meeting or exceeding standard industry and the cable manufacture's specifications. All drop F-connectors shall be hex type crimp or a "Snap and Seal" type connector. Housing to housing (KS to KS) type or 90-degree type connectors shall be used where specified by the OEM.

6. Terminator:

- a. Description: 75-Ohm terminator.
b. Specifications:

DC blocking.	Bandwidth: 50MHz-890MHz.
Return Loss: greater than 16dB.	Impedance: 75 Ohm.

7. Trunk Cable:

- a. Description: .500 inch, Semi-Rigid Coax, Riser Rated.
b. Specifications:
1. Maximum Attenuation:

2.92 dB/100ft at 700 MHz.	3.78 dB/100ft at 1000 MHz.
Impedance: 75 Ohm	

8. RG6 Cable:

- a. Description: CATV RG6 double shielded cable CM Rated
b. Specifications:
1. Attenuation:

1.48 dB/100ft at 50 MHz.	7.45 dB/100ft at 1000 MHz.
Impedance: 75 Ohm	

9. RG11 Cable:

- a. Description: CATV RG11 cable CM Rated
b. Specifications:

1. Attenuation:

0.90 dB/100ft at 50 MHz.	5.04 dB/100ft at 1000 MHz.
Impedance: 75 Ohm	

10. TV Receiver Connection Cable:

Coaxial Cable: A connection cable shall be provided by the Contractor for each TV outlet in the MATV system with 10% spares. The cable shall connect the TV receiver to the RF jack.

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 electrical and cabling contractor the location of the faceplate and the faceplate opening for the MATV backbox.
- B. Coordinate with the all signal/communication contractors the location of MATV equipment in the Telecommunications Closets. Coordinate with the contract drawings.
- C. Coordinate with the Electrical Contractor, TV Installer and Architectural Elevations for the mounting of the MATV outlet and Backbox before rough-in. TV outlets shall match the height of the electrical outlet and be at height of the installed Television for proper connections.
- D. Coordinate with the Television Supplier.

- E. Field Verify and Coordinate with COTR to identify the location to access the nearest existing viable MATV source connection to the existing MATV distribution system.
- F. Before beginning work, verify the location, quantity, size and access for the following:
 - Isolated ground AC power circuits provided for systems.
 - Primary, emergency and extra auxiliary AC power generator requirements.
 - Junction boxes, wall boxes, wire troughs, conduit and other related infrastructure for the systems.
 - System components installed by others.
- G. Immediately notify the Owner, General Contractor and Consultant in writing of any discrepancies.

3.3 NEEDS ASSESSMENT

Provide a one-on-one meeting with the particular nursing manager of each unit affected by the installation of the new HDTV MATV 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.

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, equipment racks, system cables, etc:
 - a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
 - b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.

- c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
- d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
- 5. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, Owner and 0050P3B.
- 6. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommets in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.
- B. Equipment Rack (existing provided during Phase 1):
 - 1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
 - 2. Provide security covers for all devices not requiring routine operator control.
 - 3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer's recommendations regarding ventilation space between amplifiers.
 - 4. Provide insulated connections of the electrical raceway to equipment racks.
 - 5. Provide continuous raceway and conduit with no more than 40 percent fill between wire troughs and equipment racks for all non-plenum-rated cable. Ensure each system is mechanically separated from each other in the wireway.
- C. EQUIPMENT CABINET(EXISTING PROVIDED DURING PHASE 1):
 - 1. The equipment cabinet shall be lockable, heavy gauge steel with baked on paint finish. It shall wall mounted with knock-out holes for cable entrance and provided with ventilation ports for equipment. Two (2) keys shall be provided for each lock to the Resident Engineer when the system is accepted. The keys shall be keyed alike per existing building standards.
 - 2. An AC power outlet strip(s) shall be provided with an outlet for

each item of equipment and a minimum of four (4) spare AC power outlets.

2. A minimum of 15 inches of cabinet space for additional equipment shall be provided.

D. Wiring Practice - in addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED COMMUNICATIONS CABLING SYSTEM, the following additional practices shall be adhered to:

1. Comply with requirements for raceways and boxes specified in Division 26, Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
3. Raceway shall be EMT (conduit), 3/4" Minimum. Provide larger conduit as required to accommodate homerun cable wire fills. 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 4 inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
4. 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.
5. 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.
6. 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.
7. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
8. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
9. Do not use tape-based or glue-based cable anchors.
10. Ground shields and drain wires as indicated by the drawings.

11. 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. Employ permanent strain relief for any cable with an outside diameter of 1 inch or greater.
12. Use only balanced audio circuits unless noted otherwise
13. Make all connections as follows:
 - a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
 - b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
 - c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
 - d. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.
- E. Cable Installation - In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING the following additional practices shall be adhered to:
 1. Cables shall be installed as one cable home run for each TV outlet. Daisy chain type installations will not be permitted.
 2. Install Conduits parallel to walls.
 3. 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.
 4. Ends of cables shall be properly terminated on both ends per industry and OEM's recommendations.
 5. 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.

6. Cover the end of the overall jacket with a 1 inch (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2 inches (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2 inches (minimum) past the Heatshrink and serve as indicated below.
7. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing 1/4 inch past the end of unused wires, fold back over jacket and secure with cable tie.
8. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
9. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
10. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
11. Conduit or Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

F. Labeling:

1. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
2. Engrave and paint fill all receptacle panels using 1/8 inch (minimum) high lettering and contrasting paint.
3. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8 inch (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
4. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
5. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.

6. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
7. Ensure each OEM supplied equipment has permanently attached/marked the appropriate UL Labels/Marks for the service the equipment is performed. Equipment installed not bearing these UL marks will not be allowed to be part of the system. The Contractor shall bear all costs required to provide replacement equipment with approved UL marks.

3.5 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 encounter high voltage.

3.6 CUTTING 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 MATV conduits penetrate fire rated walls, floors and ceilings, fireproof the opening.
- B. Install fire proofing material in and around all conduit and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.
- C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.

3.8 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Division 26, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- D. Do not use "3rd or 4th" wire internal electrical system conductors for ground.
- E. Do not connect system ground to the building's external lightning protection system.
- F. Do not "mix grounds" of different systems.

PART 4 - TESTING/GUARANTEED/TRAINING

4.1 SYSTEM CLASSIFICATION

The HDTV MATV System is FCC and NFPA listed. Therefore, the following testing and guaranty provisions are the minimum to be performed and provided by the contractor and Warranted by the OEM.

4.2 PROOF OF PERFORMANCE TESTING

- A. Intermediate Testing:
 - 1. After completion of 25 - 30 percent of the installation of a head end cabinet(s) and equipment, one wing of HDTV MATV outlets and interconnection to the corresponding Nurse Call System and prior to any further work, this portion of the system must be pretested, inspected, and certified. Each item of installed equipment shall be

checked to ensure appropriate FCC listing and UL certification labels are affixed, NFPA, Emergency, Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.

2. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by a local Government Representative and maintained on file by the Resident Engineer (RE), until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 75 percent of the system construction phase, at the direction of the Resident Engineer.

B. Pretesting:

1. Upon completing installation of the system, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
2. Pretesting Procedure:
 - a. During the system pretest the Contractor shall verify (utilizing approved test equipment) that the system is fully operational and meets all the system performance requirements of this standard.
 - b. The Contractor shall pretest and verify that all system functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. At a minimum, each of the following locations shall be fully pretested:
 - 1) Antennas.
 - 2) Lightning Grounds.
 - 3) Head End.
 - 4) Local and Remote Control Units/Enunciation Panels.
 - 5) All Networked locations.
 - 6) System interface locations (i.e.PA, Auditorium Audio, etc.).
 - 7) System trouble reporting.
 - 8) UPS operation.
 - 9) Primary and Emergency AC Power Requirements
 - 10) Extra Auxiliary Generator Requirements.

3. The Contractor shall provide 4 copies of the recorded system pretest measurements and the written certification that the system is ready for the formal acceptance test shall be submitted to the Resident Engineer.

C. Acceptance Test:

1. After the system has been pre-tested and the Contractor has submitted the pretest results and certification to the Resident Engineer, then the Contractor shall schedule an acceptance test date and give the Resident Engineer 30 days written notice prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative and an OEM certified representative. The system shall be tested utilizing the approved test equipment to certify proof of performance and FCC compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
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 4 hours, shall be cause for terminating the acceptance test of the system. Repeated failures that result in a cumulative time of 8 hours to affect repairs shall cause the entire system to be declared unacceptable. Retesting of the entire system shall be rescheduled at the convenience of the Government.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:
 - a. The VACO Government Representative will tour all major areas where the system is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of

installed equipment shall be checked to ensure appropriate UL certification labels are affixed.

- b. The system diagrams, record drawings, equipment manuals, Telecommunications Infrastructure Plant (TIP) AutoCAD 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 antennas, head end terminating and control equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter shall be utilized to accomplish this requirement.
 - b. Following the interface with the existing Head End equipment, a TV shall be connected to the remote amplifier's output test tap to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.
 - c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last leg to verify that the HDTV MATV video, audio and control signals meets all system performance standards.
 - d. Each HDTV MATV outlet shall be functionally tested at the same time utilizing the Contractor's approved hospital grade TV receiver and Spectrum Analyzer.
 - e. The Nurse Call System Interface and volume stepper switches shall be checked to insure proper operation of the pillow speaker and the volume stepper.
 - f. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system.
 - g. Individual Item Test: The VACO Government Representative will select individual items of equipment for detailed proof of performance testing until 100percent of the system has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.

3. Test Conclusion:

- a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the Resident Engineer. Any retesting to comply with these specifications will be done at the Contractor's expense.
- b. If the system is declared unacceptable without conditions, all rescheduled testing expenses will be borne by the Contractor.

E. Acceptable Test Equipment:

1. The test equipment shall furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
 - a. Spectrum Analyzer.
 - b. Signal Level Meter.
 - c. Volt-Ohm Meter.
 - d. Sound Pressure Level (SPL) Meter.
 - e. Oscilloscope.
 - f. Pillow Speaker Test Set (Pillow Speaker with appropriate load and cross connections in lieu of the set is acceptable).

4.3 SYSTEM GUARANTEE PERIOD OF SERVICE

A. Contractor's Responsibility:

1. The Contractor shall guarantee that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the system by the VA. The Contractor shall provide OEM's equipment warranty documents, to the Resident Engineer (or Facility Contracting Officer if the Facility has taken possession of the building), that certifies each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability

shall be provided by the Contractor and OEM at no additional cost to the VA.

3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide 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 Guarantee Period:
 - a. Response Time during the Two Year Guarantee Period:
 - 1) The Resident Engineer (or Facility Contracting Officer if the system has been turned over to the Facility) is the Contractor's only official reporting and contact official for MATV system trouble calls, during the guarantee period.
 - 2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the Resident Engineer (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
 - 3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
 - a) A routine trouble call within 1 working day of its report. A routine trouble is considered a trouble that causes a pillow speaker or cordset, 1 master IC control station, room station or emergency station 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 Resident Engineer (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.
 - c) An emergency trouble call within 4 hours of its report. An emergency trouble is considered a trouble that causes a sub-system (ward), distribution point, terminal cabinet, or all call system to be inoperable at anytime.
 - 4) If a HDTV MATV component failure cannot be corrected within 6 hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate HDTV MATV equipment. The alternate equipment/system shall be operational within a maximum of 18 hours after the 6 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 One Year Guarantee Period:

- 1) The Contractor shall visit, on-site, as necessary, during the guarantee period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the system according the descriptions identified in this document.
- 2) The Contractor shall arrange all Facility visits with the Resident Engineer (or Facility Contracting Officer) prior to performing the required maintenance visits.
- 3) Preventive maintenance shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the Resident Engineer (or Facility Contracting Officer) and Contractor.
- 4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the Resident Engineer (or Facility Contracting Officer).
- 5) The Contractor shall provide the Resident Engineer (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the Resident Engineer with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:
 - a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to Resident Engineer (or Facility Contracting Officer) by the fifth (5th) working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future

needs of the equipment and systems for preventive and predictive maintenance.

- b) The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the system. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.

- 6) The Resident Engineer (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, 2 copies of actual reports for evaluation.

- a) The Resident Engineer (or Facility Contracting Officer) shall ensure a copy of these reports is entered into the system's official acquisition documents.

- b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the system's official technical record documents.

B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the Resident Engineer or Facility Contracting Officer in writing upon the discovery of these incidents. The Resident Engineer or Facility Contracting Officer will investigate all reported incidents and render applicable judgment.

4.4 TRAINING

A. Provide thorough training of the owner's engineering and maintenance staff.

B. Provide the following minimum training times and durations:

- 1. 1 hours prior to opening
- 2. 1 hours during the opening week
- 3. 1 hours for supervisors and system administrators

- - - E N D - - -

SECTION 27 51 16
PUBLIC ADDRESS MASS NOTIFICATION AND LOCAL PAGING SYSTEMS

PART 1 - GENERAL

1.1 SECTION SUMMARY

- A. Work covered by this document includes design, engineering, labor, material, products, guaranty, training and services for, and incidental to, the complete installation of a new and fully operating National Fire Protection Association (NFPA) Listed Emergency/Public Safety Public Address and Mass Notification communication (PA) system and Local Urgent Care/Clinic Waiting Paging System as detailed herein.
- B. Work shall be complete, tested, labeled, certified and ready for operation

1.2 RELATED SECTIONS

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 Volts and Below)
- C. Section 26 41 00, FACILITY LIGHTNING PROTECTION
- D. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
- E. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS
- F. Section 27 10 00, STRUCTURED CABLING
- G. Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING
- H. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS
- I. Section 01 00 00, GENERAL REQUIREMENTS

1.3 DEFINITIONS

- A. Provide: Design, engineer, furnish, install, connect complete, test, certify and guarantee.
- 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

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/Codes:

a. Departments of:

1) CFR, Title 15 - Department of Commerce, 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 Federal communications Commission (FCC) Title 47 (CFR), Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions and Locations.

2) CFR, Title 29, Department of Labor, Chapter XVII - Occupational Safety and Health Administration (OSHA), Part 1910 - Occupational Safety and Health Standard:

a) Subpart 7 - Definition and requirements for a National Recognized Testing Laboratory (NRTL - 15 Laboratory's, for complete list, contact

http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html)

(1) Underwriter's Laboratories (UL):

65	Standard for Wired Cabinets.
468	Standard for Grounding and Bonding Equipment.

1449	Standard for Transient Voltage Surge Suppressors.
1069	Hospital Signaling and Nurse Call Equipment.
60950-1/2	Information Technology Equipment - Safety.

- (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.
- 3) Title 42, CFC, Department of Health, Chapter IV Health and Human Services, Subpart 1395(a)(b) Joint Commission on Accreditation of Healthcare Organizations (JCAHO) "a hospital that meets JCAHO accreditation is deemed to meet the Medicare conditions of Participation by meeting Federal Directives:" All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.
- 4) All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.
- 5) CFR, Title 47 - Telecommunications, FCC: 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).
- 6) Public Law No. 100-527, Department of Veterans Affairs:
- a) Office of Telecommunications:
- (1) Handbook 6100, Telecommunications.
- 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) Spectrum Management FCC and NTIA Radio Frequency Compliance
and Licensing Program.

2. National Codes:

- a. American Institute of Architects (AIA): Guidelines for Healthcare Facilities.
- b. American National Standards Institute/Electronic Industries Association and Telecommunications Industry Association (ANSI/EIA/TIA):

568-B	Commercial Building Telecommunications Wiring Standards:
569	Commercial Building Standard for Telecommunications Pathways and Spaces.
606	Administration Standard for the Telecommunications Infrastructure of Communications Buildings.
607	Commercial Building Grounding and Bonding Requirements for Telecommunications.
REC 127-49	Power Supplies.
RS 27	Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.

c. Institute of Electrical and Electronics Engineers (IEEE):

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.
0739- 5175/08/\$25. 00@2008IEEE	Medical Grade - Mission Critical - Wireless Networks.
C62.41	Surge Voltages in Low-Voltage AC Power Circuits.

d. NFPA:

70	National Electrical Code (current date of issue) - Articles 517, 645 and 800.
75	Standard for Protection of Electronic Computer Data- Processing Equipment.
77	Recommended Practice on Static Electricity.
99	Healthcare Facilities.
101	Life Safety Code.

3. State Hospital Code(s).

4. Local Codes.

1.5 QUALIFICATIONS

- A. The OEM shall have had experience with 3 or more installations of Public Address 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 1 year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.
- B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of 3 years. The Contractor shall be authorized by the OEM to pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the system. This documentation, along with the system Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.
- C. The Contractor's Communications Technicians assigned to the system shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the system. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the Resident Engineer before being allowed to commence work on the system.
- D. Applicable national, state and local licenses.
- E. Certificate of successful completion of OEM's installation/training school for installing technicians of the equipment being proposed.

1.6 CODES AND PERMITS

- 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.

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

- 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 (0050P3B - herein after referred to as 0050P3B) will not review any submittal that does not have this list.
- D. Provide four copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C and D, at a minimum for compliance review as described herein where each responsible

individual(s) shall respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).

- E. Provide Installation drawings demonstrating floor plan layout, all devices, connections and interfaces to the existing systems.

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. Provide final As built drawings to COTR in AutoCAD 2007 Format.
- B. The floor plans shall be marked in pen to include the following:
1. All device locations with labels.
 2. Conduit locations.
 3. Head-end equipment and specific location.
 4. Wiring diagram.
 5. Labeling and administration documentation.
 6. Warranty certificate.
 7. System test results.

1.10 WARRANTIES AND GUARANTY

- A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of 1 year from the date of acceptance of the project by the owner. The Contractor shall agree to remedy covered defects within eight (8) hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.
- B. Refer to Part 4 for applicable System Guarantee requirements.

1.11 USE OF THE SITE

- A. Use of the site shall be at the GC's direction.
- B. Coordinate with the GC for lay-down areas for product storage and administration areas.
- C. Coordinate work with the GC and their sub-contractors.
- D. Access to buildings wherein the work is performed shall be directed by the GC.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Store products in original containers.

- C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.
- D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

1.13 PROJECT 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. As Builts in AutoCAD 2007 Format.
 - 5. Instruction manuals and software that is a part of the system.
- C. Contractor shall submit written notice that:
 - 1. Contract Documents have been reviewed.
 - 2. Project has been inspected for compliance with contract.
 - 3. Work has been completed in accordance with the contract

PART 2 - PRODUCTS AND FUNCTIONAL REQUIREMENTS

2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

- A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.
- C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

2.2 SYSTEM DESCRIPTION

- A. This document specifies the furnishing, installing, and testing of a complete and operating extension to an existing Public Address (PA) System (here-in-after referred to as "the System"), extension to an

existing Local Urgent Care Paging System and associated equipment to be installed in the VA Medical Center here-in-after referred to as "the Facility". The system shall include, but not be limited to, distribution cabinets, volume attenuators, cable and connectors, and necessary passive devices such as terminal blocks, ceiling speakers, wiring and other options such as, sub zoning in addition to "all call" functions, microphones, computer interfaces, printer interfaces and wireless network interfaces, (when specifically approved by 0050P3B and VA Headquarters Spectrum Management 0050P2B - herein after referred to as 0050P2B) as shown on drawings. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating nurse/patient communications network.

- B. The System shall be delivered free of engineering, manufacturing, installation, and operating defects. It shall be engineered and installed for ease of operation, maintenance, and testing.
- C. The total System shall be provided so that the installation, interfacing, integration, combining, and/or consolidation of equipment actually employed does not produce any undesirable aural effects such as signal distortions, noise pulses, glitches, audio hums, voltage or spike transients, etc.
- D. The PAS shall provide using existing zoned, one-way voice paging through distributed, ceiling mounted loudspeakers. Voice input into the PAS is by zone using the telephone system.
- E. The Systems are defined as an Emergency Communication Life Safety Systems by the National Fire Protection Association (NFPA). However, it's All Call Paging Function for Code One (Blue) Life Support and interconnection to the Facility's NFPA Identified Critical Care Telephone System elevates VA's classification of the System's Emergency Communication Rating To Critical Care. Therefore, its installation and operation shall adhere to all appropriate National, Government, and/or Life Safety and/or Support Codes, which ever are the more stringent for this Facility. Additionally, the original equipment manufacturer's (OEM) recommendations and guidelines shall be followed. The OEM and Contractor shall ensure that all management, sales, engineering, and installation personnel have read and understand the requirements of this specification before the System is designed, engineered, delivered, and provided.

- F. The PAS shall interface with any existing paging system so that a global page (aka "all call" page) is communicated to the existing paging system and the new PAS of this project. Arrangements for interconnection of the PAS and the telephone system(s) shall be coordinated with the owner and the PBX provider. The PAS shall allow voice pages to be made within a single zone, across programmed multiple zones or a global page (all zones) by using preset codes entered into the keypad of any telephone attached to the PBX.
- F. The COTR is the approving authority for all contractual and mechanical changes to the System. The Contractor is cautioned to obtain, in writing, approvals for system changes relating to the published contract specifications and drawings, from the RE before proceeding with any proposed changes.
- G. When the PAS system is approved to connect to a separate communications system (i.e. LAN, WAN, Telephone, Nurse Call, radio paging, wireless systems, etc) the connection point 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 Spectrum Management 0050P3B and 0050P2B):
1. UL 60950-1/2.
 2. FIPS 142.
 3. FCC Part 15 Listed Radio Equipment is not allowed.
- H. 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 based on the speakers indicated on the drawings. Additional components required to provide a complete and operable extension of the existing Public Address System shall be provide to extend all functions and required paging zones into the project area.

2.3 MANUFACTURERS

- A. The products specified shall be new, UL Listed, and produced by OEM manufacturer of record.
- B. The following equipment items are the salient requirements of VA to provide an acceptable system described herein.

2.4 TELEPHONE INTERFACE - EXISTING

- A. Paging Adaptor:

1. The Contractor shall insure that the existing Telephone Interface is maintained and that the existing paging is extended into the expansion area.

B. Local Paging Microphone (Urgent Care/Clinic Waiting Local Paging System):

1. The Contractor shall insure that the existing Local Paging Microphone Interface is maintained and expanded as required and that the existing local paging is extended into the expansion area. Additional equipment shall be installed as necessary to expand the number of input microphones for this project.
2. Install a new Local paging microphone for the new Clinic Waiting reception desk to match the existing in Urgent Care.

2.5 HEAD-END EQUIPMENT - AS NECESSARY

- A. Provide all required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system listed in Paragraph 2.3. Head-end components may be rack mounted or wall mounted in a metal enclosure. Additions to the existing head-end system maybe required to meet the intent of the specification.

2.6 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 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 Resident Engineer) the color of the adjacent surfaces.
11. Provide one spare speaker, mount, and back box for each 20 speakers or portion thereof.

2.7 VOLUME ATTENUATOR

1. Provide Volume Attenuators as required by this specification or as shown on the drawings. Each unit shall be a standard OEM product. Provide one spare attenuator unit, cover plate, appropriate knobs, and back box for every 20 units or portion thereof.
2. Technical Characteristics:

Components	Mounted on a common wall plate at the factory.
Wall cover plates	Satin stainless steel with an adjustable dial scale to indicate the amount of attenuation. Equip the scale to stop at the 360 degree point. Mark the wall plate with "PAD" Volume Control in the areas not shared with the RED System. Mark the wall plate with "RED and PA" Volume Control in the areas shared with the PA System.
Control knob	Required
Positive stop	Required for each position
Volume controls	Wire wound, continuous rotation type, constant impedance type with control knobs.

2.8 DESKTOP MICROPHONE - (LOCAL PAGING SYSTEM)

- A. Desktop microphone with push to talk button to initiate paging.
- B. Dynamic Microphone With dual-impedance.
- C. Uni-directional pick-up pattern.
- D. Impedance: Hi-Z, 50k ohms; Lo-Z, 500 ohms
- E. Frequency response range 45 Hz-15 kHz
- F. Sensitivity of -72dB +/- 3dB
- G. Connections to standard XLR connectors on Microphone cable and Single Gang Stainless Steel Wall Plate to be mounted in casework.

2.8 SYSTEM CABLES

- A. Refer to OFM approved Construction Specification 27 10 00, STRUCTURED CABLING for specific installation and testing requirements.
- B. Speaker Level Audio Cable (70v):
 - 1. For use with 70-volt speaker circuits.
 - 2. 16AWG stranded pair, minimum.
- C. Speaker Level Audio Cable, Plenum Rated (70v):
 - 1. For use with 70-volt speaker circuits.
 - 2. 16AWG stranded pair, minimum.
- D. Line Level Audio and Microphone Cable:
 - 1. Line level audio and microphone cable for inside racks and conduit.
 - 2. Shielded, twisted pair Minimum 22AWG, stranded conductors and 24AWG drain wire with overall jacket.
 - 3. Twisted pair Minimum 22AWG, stranded conductors with overall jacket for push to talk operation.
- E. All cabling shall be riser rated.
- F. Provide 1 spare 1,000 foot roll of approved system (not microphone) cable only.

2.9 RACEWAYS

- A. Intercommunication and Program System Raceways and Boxes: Comply with requirements in Division 16 Section "Raceway and Boxes for Electrical Systems."
- B. Public Address System Cable infrastructure: Install in 3/4" EMT Conduit.
- C. Junction boxes shall be not less than 2-1/2 inches deep and 6 inches wide by 6 inches long.
- D. Flexible metal conduit is prohibited unless specifically approved by 0050P3B.

2.10 CONDUIT

- A. The electrician shall provide 3/4" EMT Conduit as shown on the drawings.
- B. Provide fireproofing where necessary. Provide a UL listed Through Penetration Firestop System.

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 electrical contractor the location of the speaker backboxes and backboxes for attenuators.
- B. Field Verify and Coordinate with COTR to identify the location to access the nearest existing viable PA Zone source connection to the existing Public Address System.
- C. Before beginning work, verify the location, quantity, size and access for the following:
 - Isolated ground AC power circuits provided for systems.
 - Primary, emergency and extra auxiliary AC power generator requirements.
 - Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.
 - System components installed by others.
 - Overhead supports and rigging hardware installed by others.
- D. Immediately notify the Owner, General Contractor and Consultant in writing of any discrepancies.

3.3 INSTALLATION

A. General:

1. Execute work in accordance with National, State and local codes, regulations and ordinances.
2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the Owner.
3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
4. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc:
 - a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
 - b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
 - c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
 - d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
5. Locate overhead ceiling-mounted loudspeakers as shown on drawings, with minor changes not to exceed 12" in any direction:
 - a. Mount transformers securely to speaker brackets or enclosures using screws. Adjust torsion springs as needed to securely support speaker assembly.
 - b. Speaker back boxes shall be completely filled with fiberglass insulation.
 - c. Seal cone speakers to their enclosures to prevent air passing from one side of the speaker to the other.
6. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, Owner and 0050P3B.
7. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and

surrounding wall. Where cover plates are not fitted with connectors, provide grommets in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.

B. Terminal Cabinet (Existing Provided During Phase 1):

1. Provide security covers for all devices not requiring routine operator control.
2. Provide vent panels and cooling fans as required or as necessary for the operation of any required equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer's recommendations regarding ventilation space between amplifiers.
3. Provide continuous conduit with no more than 40 percent fill between wire troughs and equipment racks for all non-plenum-rated cable.

C. Wiring Practice: In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING, the following additional practices shall be adhered to:

1. 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 loudspeaker 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 inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
5. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.

6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
7. Replace the entire length of the run of any wire or cable that is damaged or abraided during installation. There are no acceptable methods of repairing damaged or abraided wiring.
8. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
9. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
10. Do not use tape-based or glue-based cable anchors.
11. Ground shields and drain wires 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 15percent 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 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.

- D. Cable Installation: In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING, the following additional practices shall be adhered to:
1. Install all cable in 3/4" Conduit.
 2. Install conduit parallel to walls.
 3. 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.
 4. Ends of cables shall be properly terminated on both ends per industry and OEM's recommendations.
 5. 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.
 6. 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 Heat-shrink and serve as indicated below.
 7. 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.
 8. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
 9. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
 10. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
 11. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
 12. Conduit and 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 and drain wires 2" (minimum) past the Heat-shrink and serve as indicated below.
 - b. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing 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.

E. Labeling:

1. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
2. Engrave and paint fill all receptacle panels using 1/8" (minimum) high lettering and contrasting paint.
3. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8" (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
4. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
5. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
6. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.

7. Ensure each OEM supplied equipment has appropriate UL Labels/Marks for the service the equipment is performed permanently attached/marked. Equipment installed not bearing these UL marks will not be allowed to be part of the system. The Contractor shall bear all costs required to provide replacement equipment with approved UL marks.

3.4 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.

3.5 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.

3.6 FIREPROOFING

- A. Where Public Address Conduits penetrate fire rated walls, floors and ceilings, fireproof the opening.
- B. Provide fire proofing material in and around all conduit and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.
- C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.

3.7 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Division 26, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- D. Do not use "3rd or 4th" wire internal electrical system conductors for ground.
- E. Do not connect system ground to the building's external lightning protection system.
- F. Do not "mix grounds" of different systems.

PART 4 - TESTING/GUARANTY/TRAINING

4.1 SYSTEM CLASSIFICATION

The PAS System is NFPA listed as an "Emergency and Public Safety" Communications system. Where Code Blue signals are transmitted, that listing is elevated to "Life Support." 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 percent the installation, this portion of the system must be pre-tested, inspected, and certified, prior to any further work. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed, NFPA, Life Safety, and JCAHCO guidelines are followed, and proper

installation practices are followed. The intermediate test shall include a full operational test.

2. The inspection and test will be conducted by a factory-certified representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by the Government Representative and maintained on file by the Resident Engineer (RE), until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 75 percent of the system construction phase, at the direction of the Resident Engineer.

B. Pretesting:

1. Upon completing installation of the PAS System, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.

2. Pretesting Procedure:

- a. During the system pretest the Contractor shall verify (utilizing approved test equipment) that the system is fully operational and meets all the system performance requirements of this standard.
- b. The Contractor shall pretest and verify that all system functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc., are present. At a minimum, each of the following locations shall be fully pre-tested:
 - 1) Central Control Cabinets.
 - 2) PA Control Stations.
 - 3) Zone Equipment/Systems.
 - 4) Sub-Zone Equipment/Systems.
 - 5) Local and Remote Enunciation Panels.
 - 6) All Networked locations.
 - 7) System interface locations (i.e. TELCO, two way radio, etc.).

3. The Contractor shall provide four copies of the recorded system pretest measurements and the written certification that the system is ready for the formal acceptance test shall be submitted to the Resident Engineer.

C. Acceptance Test:

1. After the system has been pre-tested and the Contractor has submitted the pretest results and certification to the Resident Engineer, then the Contractor shall schedule an acceptance test date and give the Resident Engineer 30 days written notice prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative and an OEM certified representative. The system shall be tested utilizing the approved test equipment to certify proof of performance and Emergency and Public Safety 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 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 4 hours, shall be cause for terminating the acceptance test of the system. Repeated failures that result in a cumulative time of 8 hours to affect repairs shall cause the entire system to be declared unacceptable. Retesting of the entire system shall be rescheduled at the convenience of the Government.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:

- a. The VACO Government Representative will tour all major areas where the system is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
- b. The system diagrams, record drawings, equipment manuals, Telecommunications Infrastructure Plant (TIP) Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.

- c. Failure of the system to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test:

- a. After the Physical and Mechanical Inspection, the central terminating and Public Address System 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 central equipment test 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 distribution system meets all system performance standards.
- d. 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.
- e. 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 10 minutes of UPS operation, electrical supervision, trouble panel, corridor speakers and audio paging.
- f. Individual Item Test: The Government Representative will select individual items of equipment for detailed proof of performance testing until 100 percent of the system has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.

3. Test Conclusion:

- a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the Resident Engineer. Any retesting to comply with these specifications will be done at the Contractor's expense.
- b. If the system is declared unacceptable without conditions, all rescheduled testing expenses will be born by the Contractor.

E. Acceptable Test Equipment

1. The test equipment shall furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
 - a. Spectrum Analyzer.
 - b. Signal Level Meter.
 - c. Volt-Ohm Meter.
 - d. Sound Pressure Level (SPL) Meter.
 - e. Oscilloscope.
 - f. Random Noise Generator.
 - g. Audio Amplifier with External Speaker.

4.3 SYSTEM GUARANTEE PERIOD OF SERVICE

A. Contractor's Responsibility:

1. The Contractor shall guarantee that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the system by the VA. The Contractor shall provide OEM's equipment warranty documents, to the Resident Engineer (or Facility Contracting Officer if the Facility has taken possession of the building), that certifies each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the Contractor and OEM at no additional cost to the VA.
3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide 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 guarantee period:
 - a. Response Time during the Two Year Guarantee Period:
 - 1) The Resident Engineer (or Facility Contracting Officer if the system has been turned over to the Facility) is the

Contractor's only official reporting and contact official for PA system trouble calls, during the guarantee period.

- 2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the Resident Engineer (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
 - 3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
 - a) A routine trouble call within 1 working day of its report.
A routine trouble is considered a trouble which causes a pillow speaker or cordset, 1 master IC control station, room station or emergency station 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 Resident Engineer (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.
 - c) An emergency trouble call within 4 hours of its report. An emergency trouble is considered a trouble which causes a sub-system (ward), distribution point, terminal cabinet, or all call system to be inoperable at anytime.
 - 4) If a PAS component failure cannot be corrected within four hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate nurse call equipment. The alternate equipment/system shall be operational within a maximum of 20 hours after the four 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, as necessary, during the guarantee period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain

the system according the descriptions identified in this document.

- 2) The Contractor shall arrange all Facility visits with the Resident Engineer (or Facility Contracting Officer) prior to performing the required maintenance visits.
- 3) Preventive maintenance shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the Resident Engineer (or Facility Contracting Officer) and Contractor.
- 4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the Resident Engineer (or Facility Contracting Officer).
- 5) The Contractor shall provide the Resident Engineer (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the Resident Engineer with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:
 - a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to Resident Engineer (or Facility Contracting Officer) by the fifth (5th) working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.
 - b) The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the system. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.

6) The Resident Engineer (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, 2 copies of actual reports for evaluation.

a) The Resident Engineer (or Facility Contracting Officer) shall ensure a copy of these reports is entered into the system's official acquisition documents.

b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the system's official technical record documents.

B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the Resident Engineer or Facility Contracting Officer in writing upon the discovery of these incidents. The Resident Engineer or Facility Contracting Officer will investigate all reported incidents and render an applicable judgment.

4.4 TRAINING

A. Provide thorough training of the owner's engineering and maintenance staff.

B. Provide the following minimum training times and durations:

1. 2 hours prior to opening
2. 2 hours during the opening week
3. 2 hours for supervisors and system administrators

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SECTION 27 52 23
TONE VISUAL NURSE CALL SYSTEM

PART 1 - GENERAL

1.1 SECTION SUMMARY

- A. Work covered by this document includes design, engineering, labor, material, products, guaranty, training and services for, and incidental to, the complete installation of a new and fully operating National Fire Protection Association (NFPA) Listed Critical Service Nurse Call communication system as detailed herein.
- B. Work shall be complete, tested, labeled, certified and ready for operation.

1.2 RELATED SECTIONS

- A. Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Specification Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Specification Section 27 10 00, STRUCTURED CABLING.
- E. Specification Section 26 27 26, WIRING DEVICES.
- F. Specification Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- G. Specification Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- H. Specification Section 10 25 13, PATIENT BED SERVICE WALLS.
- I. Specification Section 27 11 00, COMMUNICATIONS EQUIPMENT ROOM FITTINGS and Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
- J. Section 01 00 00, GENERAL REQUIREMENTS

1.3 DEFINITIONS

- A. Provide: Design, engineer, furnish, install, connect complete, test, certify and guarantee.
- B. Work: Materials furnished and completely installed.
- C. Review of contract drawings: A service by the engineer to reduce the possibility of materials being ordered which do not comply with contract documents. The engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute permission for the Contractor to proceed in error.

- D. Headquarters (aka VACO) Technical Review, for National and VA Communications and Security, Codes, Frequency Licensing Standards, Guidelines and Compliance:

Office of Telecommunications
Special Communications Team (0050P3B)
1335 East West Highway - 3rd Floor
Silver Spring, Maryland 20910,
(O) 301-734-0350, (F) 301-734-0360

- E. Engineer: VA San Diego project Engineer
F. Owner: VA San Diego Health Care System
G. Contractor: Systems Contractor; you; successful bidder.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. Except for a specific date given the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of the System's submittal is technically approved by the VA, shall be enforced.
- B. National Fire Protection Association (NFPA):

70	National Electrical Code (NEC)
77	RECOMMENDED PRACTICE ON STATIC ELECTRICITY
99	Standard for Health Care Facilities
101	Life Safety Code

- C. Underwriters Laboratories, Inc. (UL):

65	Standard for Wired Cabinets
467	Standard for Grounding and Bonding Equipment
1069	Standard for Hospital Signaling and Nurse Call Equipment
1410	Standard for Television Receivers and Video Products
1778	Standard for Uninterruptable Power Supply

D. U.S. National Archives and Records Administration (NARA):

47 CFR 15	Radio Frequency Devices
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E. Electronic Industries/Telecommunications Industries Associations
(EIA/TIA):

568	Commercial Building Telecommunications Wiring Standard
569	Commercial Building Telecommunications Pathways and Spaces Standard
606	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
607	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
RS-270	Tools, Crimping, Solderless Wiring Devices Recommended Procedures for User Certification

F. Joint Commission on Accreditation of Health Care Organization (JCAHCO):
Comprehensive Accreditation Manual for Hospitals

G. National and/or Government Life Safety Codes(s): The more stringent of
each listed code.

1.5 QUALITY ASSURANCE

- A. The authorized representative of the System's OEM shall be responsible for the design, satisfactory total operation of the System, and its certification.
- B. The OEM shall meet the minimum requirements identified in paragraph 2.1.A. Additionally, the OEM shall have had experience with three or more installations of systems of comparable size and complexity as regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Each of these installations shall have been in successful operation for at least three years after final acceptance by the user. These installations shall be provided as a part of the submittal identified in paragraph 1.5.

- C. The System Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The System Contractor shall be authorized by the OEM to certify and warranty the installed equipment. In addition, the OEM and System Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System. This documentation, along with the System Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.
- D. 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.

1.6 DESCRIPTION

- A. This document specifies the furnishing, installing, and testing of a complete and operating Audio - Visual (Tone-Visual) Nurse Call System here-in-after referred to as "the System", and associated equipment to be installed in the VA Medical Center, here-in-after referred to as "the Facility". The System shall be microprocessor based and include, but not be limited to: central terminal assemblies; nurse call control panel; nurse station annunciator; emergency stations, toilet emergency stations, duty, and dome lights; uninterruptible power supplies (UPS); conduit, cable duct, and/or cable tray; and necessary passive devices such as, cable, wire, and connectors.
- B. The System shall be delivered free of engineering, manufacturing, installation, and operating defects. It shall be engineered and installed for ease of operation, maintenance, and testing.
- C. The total System shall be designed and installed so that the installation, interfacing, integration, combining, and/or consolidation of equipment actually employed does not produce any undesirable visual or aural effects such as signal distortions, noise pulses, glitches, audio or video hum bars, transients, ghosting, etc.
- D. The System is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Therefore, its installation and operation shall adhere to all appropriate National and/or Government Local Life Safety and/or Support Codes, whichever are

the more stringent for this Facility. Additionally, the original equipment manufacturer's (OEM) recommendations and guidelines shall be followed. The OEM and Contractor shall ensure that all management, sales, engineering, and installation personnel have read and understand the requirements of this specification before the System is designed, engineered, delivered, and provided.

E. The VA Project Manager (PM) and/or if delegated Resident Engineer (RE) are the approving authority for all contractual and operational changes to the System. The Contractor is cautioned to obtain in writing, approvals for system changes relating to the published contract specifications and drawings, from the PM and/or the RE before proceeding with any proposed change.

F. Equipment Standards and Product Testing:

1. All equipment and materials (other than specific nurse call items) used in providing the System shall be listed, labeled and certified by UL or a nationally recognized testing laboratory where such standards have been established for the utilized items. Such listing and labeling shall warrant that the equipment has been tested in accordance with, and conforms to the specified standards.

2. The provided active and passive nurse call 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 the technical submittal (or the date when the RE approved system equipment necessary to be replaced) was technically reviewed and approved by the VA. Where a UL standard is in existence for equipment to be used in completion of this contract, a test must be conducted to certify the equipment meet the published UL standard. This test must be conducted by UL that makes periodic inspections of the production of nurse call equipment. The Contractor's technical submittal shall include UL 1069 certification and/or documents supplied by the testing laboratory that indicate each piece of equipment to be furnished conforms to UL 1069 standards, where such standards exist:

1. Each item of 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.

2. At a minimum, the entire system shall meet or exceed UL 1069 Standard and be listed so in UL's published literature. The Contractor shall provide a copy of the entire UL 1069 published listing as a part of the technical submittal.

1.7 SUBMITTALS

- A. Provide submittals in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The RE shall retain one copy for review and approval.
 1. If the submittal is approved the RE shall retain one copy for Official Records and return three (3) copies to the Contractor.
 2. If the submittal is disapproved, three (3) copies will be returned to the Contractor with written explanation attached indicating the areas the submittal deviated from the System specifications. The RE shall retain one copy for Official Records.
- B. Documents: The submittal shall be separated into sections for each sub-system and shall contain the following:
 1. Title page to include:
 - a. Facility name
 - a. VA Project Name
 - c. Contractor's name, address, and telephone (including FAX) numbers
 - d. Date of Submittal
 - e. VA Project Number
 2. A list containing a minimum of three locations of installations of similar size and complexity as identified herein. These locations shall contain the following:
 - a. Facility location and name
 - b. Owner's or User's name, address, and telephone (including FAX) numbers
 - c. Date of Project Start and Date of Final Acceptance by Owner
 - d. System Project Number
 - e. Brief (three paragraphs minimum) description of each system's function, operation and installation
 3. Narrative Description of the system as it is expected to be installed.

The following are the minimum equipment required by the System:

QUANTITY	UNIT
As required	Central Control Equipment and Cabinet
As required	Nurse Station Tone Visual Annunciator
As required	Duty Station
As required	Corridor Dome Lights
As required	Intersectional Dome Lights (Zone)
As required	Wires and Cables
As required	General Station Connectors
As required	Toilet Emergency Station
As required	Emergency Push Button Station
As required	Push-buttons
1 ea.	Installation Kit
As identified	Separate List of each Equipment Spare(s)

4. Detailed Shop Drawings demonstrating Floor Plans with Nurse Call Device Locations, Conduit with Wire Fills, Single Line Diagram, Point to Point Wiring Diagram and all notes and details to completely demonstrate the Systems installation and rough-in requirements.
 5. Central terminal cabinet layout drawing, as it is expected to be installed.
 6. Nurse Station with tone visual annunciator layout drawing, as it is expected to be installed.
 7. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
 8. Engineering drawings of the System, with information to determine compliance with contract drawings and specifications.
 9. List of test equipment per paragraph 1.5.C.
 10. Letter certifying that the Contractor understands the requirements of the SAMPLES paragraph 1.5.D.
 11. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning tests.
- C. Test Equipment List:
1. The Contractor is responsible for furnishing all test equipment required to test the System in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be

- considered part of the System. The Contractor shall furnish test equipment of accuracy better than the parameters to be tested.
2. The test equipment furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
 - a. Spectrum Analyzer
 - b. Signal Level Meter
 - c. Volt-Ohm Meter
 - d. Sound Pressure Level (SPL) Meter
 - e. Sound Pressure Level (SPL) Calibrator
 - f. Random Noise Generator
- D. Samples: A sample of each of the following items shall be furnished to the RE for approval prior to installation.
1. 610 mm (2 foot) section of each cable to be used with connectors installed and OEM cable sweep compliance and/or certification tags as specified in paragraph 2.3.F.
 2. Back boxes for the nurse call patient stations, dome lights, duty stations, annunciator panels, and junction boxes.
 3. Cover plates used for duty stations, annunciator panels and emergency stations.
 4. UPS equipment (or back-up batteries).
- E. Certifications
1. Submit written certification from the OEM indicating that the proposed supervisor of the installation and the proposed provider of the contract maintenance are authorized representatives of the OEM. Include the individual's exact name and address and OEM credentials in the certification.
 2. Submit written certification from the OEM that the wiring and connection diagrams meet National and/or Government Life Safety Guidelines, NFPA, NEC, UL 1066, this specification, and JCAHCO requirements and the instructions, requirements, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. The VA will not approve any submittal without this certification.
 3. Preacceptance Certification: This certification shall be made in accordance with the test procedure paragraph 3.2.B.

F. Equipment Manuals: Ten (10) working days prior to the scheduled acceptance test, the Contractor shall deliver four (4) complete sets of commercial operation and maintenance manuals for each item of equipment furnished as part of the System to the RE. The manuals shall detail the theory of operation and shall include narrative descriptions, pictorial illustrations, block and schematic diagrams, and parts list.

G. Record Wiring Diagrams:

1. Ten (10) working days prior to the acceptance test, the Contractor shall four (4) complete sets of the record wiring diagrams of the System to the RE. The diagrams shall show all inputs and outputs of electronic and passive equipment correctly identified according to the markers installed on the interconnecting cables, equipment and room/area locations.
2. The record wiring diagrams shall be in hard copy and two compact disk (CD) copies properly formatted to match the Facility's current operating version of Computer Aided Drafting (AutoCAD) system. The Contractor shall provide drawings in AutoCAD Version 2007 as used by the Facility.

H. Ten (10) days prior to the start of the intermediate test, provide a typewritten detailed description of the System testing plan that meets this specification's performance standards as indicated in paragraph 2.1.C including illustrations and utilizes the test equipment specified in paragraph 1.5.C. The test plan will need to be evaluated and approved by the RE before intermediate testing begins.

I. Provide two (2) copies of a OEM developed training video tape presentation (reference paragraph 3.3.B) for evaluation and approval by the RE.

J. Provide a typewritten document that details the complete record program in memory for all associated station assignments. PART 2 - PRODUCTS for compliance review as described herein where each responsible individual(s) should respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).

1.8 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 Record Drawings Shall be converted to AutoCAD 2007 As Built floor plans to include the following:

1. All device locations with labels.
2. Conduit locations.
3. Head-end equipment and specific location.
4. Wiring diagram.
5. Labeling and administration documentation.
6. Warranty certificate.
7. System test results.

1.9 WARRANTIES AND GUARANTY

- A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of 1 year from the date of acceptance of the project by the owner. The Contractor shall agree to remedy covered defects within 8 hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.
- B. Refer to Part 4 for applicable System Guarantee requirements.

1.10 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.

1.11 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.

1.12 PROJECT CLOSEOUT

- A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.
- B. Before the project closeout date, the Contractor shall submit:
 1. Warranty certificate.

2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
 3. Project record documents and As Builts.
 4. Instruction manuals and software that is a part of the system.
- C. Contractor shall submit written notice that:
1. Contract Documents have been reviewed.
 2. Project has been inspected for compliance with contract.
 3. Work has been completed in accordance with the contract

PART 2 - PRODUCTS AND FUNCTIONAL REQUIREMENTS

2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

- A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- B. Expansion Capability: Increase number of stations in the future by 300 percent above those indicated without adding any internal or external components or main trunk cable conductors. Allow expansion for future Phases as demonstrated on the contract drawing key plan.
- C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz. Provide a Tone-Visual System of the latest technology of the Manufacturer, Rauland-Borg or equal.
- D. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity or performance characteristics of items furnished in the System. When the Contractor furnishes an item of equipment for which there is a specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.

2.2 EQUIPMENT AND MATERIALS

- A. System Requirements:
 1. The System shall receive the specified system signals and shall process and distribute them to the designated outlet, control and/or remote locations shown on the drawings. The System shall be designed to minimize background processor noise and other signal interference.

2. The central control equipment shall be provided in the central equipment terminal cabinet ensuring that test port(s) is provided for access to each system function without the need to disconnect distribution cables or equipment.
3. Each floor or ward distribution system shall be a "buss" design where each room's nurse call equipment is fed from centrally located lateral trunk line cables. Each signal closet mounted terminal cabinet shall be capable of connection to vertical trunk line riser cables in the associated signal closet and as shown on the drawings and recommended by the OEM.
8. Each floor or ward distribution system shall be installed in conduit, 3/4" Minimum.
9. The Contractor shall provide verification in writing that the type wire/cable being furnished and installed is recommended and approved by the OEM and will provide a total system free of defects.
10. Existing Central Terminal Cabinet: The cabinet has been provided during Phase 1. All new Wiring shall be terminated at the existing equipment.
11. Central Terminal Cabinet and Master Control Station Selection:
 - a. The cabinet(s) is existing provided during Phase 1. If necessary provide expansion cabinet(s).
 - b. The tone visual annunciators(s) shall be provided and protected at the nurses stations as shown on the drawings.

D. General:

1. All equipment to be supplied under this specification shall be new and the current model of a standard product of an 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:
 - a. Maintains a stock of replacement parts for the item submitted.
 - b. Maintains engineering drawings, specifications, and operating manuals for the items submitted.
 - c. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid.
2. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be

- construed as limiting the overall quality, quantity or performance characteristics of items furnished in the System. When the Contractor furnishes an item of equipment for which there is a specification contained herein, that item of equipment shall meet or exceed the specification for that item of equipment.
3. The Contractor shall provide written verification, to the RE that the type of wire/cable being provided is recommended and approved by the OEM. Cabling shall meet the interconnecting wiring requirements of UL 1069; and the requirements of NFPA 70 (NEC). The Contractor is responsible for providing the proper size and type of cable duct and/or conduit and wiring even though the actual installation may be by another subcontractor.
 4. Active electronic component equipment shall consist of solid state components and be rated for continuous duty service in the areas where provided.
 5. All passive distribution equipment and cables shall meet or exceed - 80 dB radiation shielding specifications.
 6. All signaling and communication circuits shall be solid state except for audio switching relays.
 7. The System shall utilize microprocessor components for all signaling and programming circuits and functions. Program memory shall be non-volatile or protected from erasure from power outages for a minimum of five minutes.
 8. All voltages, except for the primary power to the power supply circuits, shall not exceed 30 VAC Root Mean Squared (RMS) or 41.2 V direct current (DC).
 9. Color code all distribution wiring to conform to the Nurse Call 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. Reference Specification Section 27 10 00, STRUCTURED CABLING and Section 27 11 00, COMMUNICATIONS EQUIPMENT ROOM FITTINGS and Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
 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 plans or if not shown on plans consult with RE regarding a suitable circuit location, prior to bidding.

11. Provide a UPS or Battery backup for the System to operate and function normally (as if there was no AC power failure) in the event of an AC power failure for a minimum of 15 minutes.
12. All equipment shall function and operate normally from the furnished power source, and also, during input power fluctuations or loss of power for a minimum of 15 minutes.
13. Plug-in connectors shall be provided to connect all stations, except emergency stations and corridor lights. Emergency stations and corridor lights shall utilize barrier terminal screw type connectors, at a minimum. Crimp type connectors installed with a ratchet type installation tool are an acceptable alternate as long as the cable dress, pairs, shielding, grounding, and connections and labeling are provided the same as the barrier terminal strip connectors. Tape of any type, wire nuts or solder type connections are unacceptable and will not be approved.
14. All equipment face plates utilized in the System shall be stainless steel, anodized aluminum or UL approved cycolac plastic that matches the equipment item it is installed. All faceplates shall be constructed of the same material throughout the facility.
15. All equipment trim plates utilized in the System shall be stainless steel, anodized aluminum or UL approved cycolac plastic that matches the equipment item and the areas where provided. Trim plates are not authorized to bear the UL label for the station unless specifically approved by UL. All trim plates shall be constructed of the same material throughout the facility.
16. Noise filters and surge protectors shall be provided for each equipment control cabinet, nurse call master station, local, and remote locations to ensure protection from input primary AC power surges and noise glitches are not induced into low voltage data circuits.
17. Passive and electronic components and cabling shall be provided under the OEM's recommendations and guidance, to prevent damage to any system equipment from electrostatic discharges of a minimum of 25,000 Volts, at a relative humidity of a maximum of 20 percent (%) or less. The Contractor shall detail in the technical submittal the

method and equipment to be utilized to protect the system components from a minimum 25,000 Volt electrostatic discharge.

E. Master Nurse Call Tone Visual annunciator shall include, but not be limited to, the following:

1. Wall mounted LED or LCD type which annunciates each type of call with associated room number/use.
2. Unique Audible Tone for each call type.
3. Provide staff with complete call activity information.

F. Dome Lights:

1. Corridor dome lights shall be provided as shown on the drawings and identified in the equipment list.
2. Room dome lights shall be provided as shown on the drawings and identified in the equipment list. Provide one spare dome light for each 20 locations, and portion thereof.

G. Equipment Functional Characteristics:

FUNCTIONS	CHARACTERISTICS
Input Voltage	105 to 130 VAC
Power Line Frequency	60 Hertz (Hz), ± 2.0 Hz
Operating Temperature	0 to 50 degrees ($^{\circ}$) Centigrade (C)
Humidity	80 %, minimum rating

2.3 CENTRAL CONTROL PANEL

A. Equipment Cabinet (Existing Provided during Phase 1):

1. Connect new Nurse Call Equipment to the Tone Visual Nurse call Controller provided during Phase 1. Provide expansion if necessary.

B. Central Terminal Equipment (Existing Provided during Phase 1):

1. Connect new Nurse Call Equipment to the Tone Visual Nurse call Controller provided during Phase 1. Provide expansion if necessary.

2.4 EQUIPMENT SPECIFICATIONS

A. Staff/Duty Station: Each staff/duty station shall be provided with:

1. The capability to indicate all patient calls placed in the System with audible and visual signals.
2. The capability to indicate all patient/emergency/code blue calls with audible and visual signals.
3. Each staff/duty station shall be mounted in the appropriately sized back box. A trim plate constructed of stainless steel or a material

similar to the staff/duty station shall be provided to cover the back box opening and frame the cover plate.

B. Toilet Emergency Station:

1. A pullcord emergency station shall be provided in each toilet stall and each shower/bath stall, one per shower head. Shower emergency stations shall be provided inside the shower stall at the shower head. Each station inside shower and toilet areas shall be equipped with a rubber gasket between the face plate and wall or be rated by UL as waterproof.
2. The gasket shall cover and water seal the entire back box opening and not extend beyond the sides of the associated face plate by 6.4 mm (1/4 inch) maximum. If the wall is tile or other uneven type material the gasket and associated face plate shall be provided to completely seal the opening and uneven material surface.
3. Each emergency station shall be mounted on a single-gang back box, minimum. A trim plate constructed of stainless steel or a material similar to the emergency station shall be provided to cover the back box opening and frame the cover plate.
4. Toilet Emergency stations shall be provided with:
 - a. A ten-pound test pull cord and pendant which shall be connected to a positive action on/off switch at the emergency station. The cord with pendant shall terminate 150 mm (6 inches) AFF.
 - b. A minimum of one pound pull to activate the switch.
 - c. A reset/cancel function on the face plate of the emergency station.
 - d. "EMERGENCY NURSE CALL" or similar approved wording stamped or permanently affixed on the face plate. The emergency wording letters shall be a minimum of 3.2 mm (1/8 inch) high.
 - e. A red lamp which shall flash at a rate of one second on and one second off upon initiation of a call from the emergency station. The lamp shall continue to flash until the station is reset.

C. Pushbutton Emergency Station:

1. A pushbutton emergency station shall be provided in each exam room and as shown elsewhere.
2. Ability to place a unique call-in priority to the assigned annunciator.
3. A reset/cancel function on the face plate of the emergency station.

4. "Push For Help" or similar approved wording stamped or permanently affixed on the face plate. The emergency wording letters shall be a minimum of 3.2 mm (1/8 inch) high.

D. Corridor Door Dome Lights:

1. Provide light/LED covers that are translucent and shall not deform, discolor or craze from heat or use of normal hospital cleaning agents.
2. Corridor door dome lights shall be provided for patient bedrooms and shall contain sufficient lamps/LEDs to permit distinguishing the following type placed calls:
 - a. Routine placed normal calls from bedside stations
 - b. Emergency placed calls from bath/toilet emergency stations, if the bedroom has such facilities
 - c. Emergency placed calls from bedside stations that are programmed in the emergency/priority mode or Staff emergency buttons.
 - d. Code Blue calls.
 - e. The visual signals for routine and emergency/priority placed calls shall be distinctly different from each other
 - f. Calls placed in the reminder/nurse aide function
3. Corridor dome lights shall be provided for congregate bath/toilet areas and shall contain one red lamp/LED.
4. Each dome light shall be mounted on a dual-gang back box, minimum. A trim plate constructed of stainless steel or a material similar to the dome light shall be provided to cover the back box opening and frame the cover plate.

I. Corridor Intersectional Dome (Zone) Lights:

1. Provide corridor intersectional lights that contain a minimum of two lamps to identify any placed call in the System. The visual signals for routine and emergency placed calls shall be distinctly different from each other.
2. Provide the light at each intersecting point of corridors that display visual signals simultaneously at all corridor intersectional lights for calls placed in the System.
3. Each light shall be mounted on a dual-gang back box, minimum. A trim plate constructed of stainless steel or a material similar to the light shall be provided to cover the back box opening and frame the cover plate.

J. Nurse Station Annunciator: Each nurse control station shall be provided:

1. As a tone-visual type, without voice communication.
2. As wall mounted: With flush mount Wall box.
3. With the following features:
 - a. LED to visually announce the location of incoming calls placed in the System including room or bed number and priority of the call. Identify each calling station with an individual display, including separate displays for each room sharing a dual stations.
 - b. Unique tone for each call type.
 - c. ability to display all call in the zone or system.
 - d. Incoming call priority function. The visual or audible signals shall indicate if a routine or emergency (and/or code) call has been placed and shall continue until the call is canceled. The emergency calls shall be canceled only at the originating station.
 - e. Reminder function. Shall temporarily store a placed call and generate visual signals in the corridor dome light associated with the calling bedside station by activating the reminder function/circuitry. The visual signals shall terminate and the stored call is eliminated from memory when the call is canceled at the originating station.
 - f. The ability to generate visual and audible signals to indicate incoming calls from associated stations which:
 - 1) The visual signals for incoming calls shall remain displayed at all times until each call is answered or canceled at the calling station.
 - 2) The visual and audible signals for routine and emergency calls shall be distinctly different. The audible signals shall be generated at the same rate as the corresponding visual signals for each emergency calls. Audible signals for routine calls shall be generated at the same rate as the visual signals, or by repeating an audible signal every five to ten seconds until the call is answered or canceled.
 - 3) The visual display to indicate the location of a placed call shall appear on the control station within two seconds, maximum, after initiation of a call.

- g. Accommodate a minimum of 15 percent expansion of additional stations within each zone or Phase area as installed without any additions to the Control Equipment. In addition insure adequate expansion capability for additional devices to be installed in subsequent Phases as demonstrated by the key plan provided in the contract drawings

2.5 DISTRIBUTION SYSTEM

Refer to Specification Sections 27 11 00, COMMUNICATIONS EQUIPMENT ROOM FITTINGS and 27 15 00, COMMUNICATIONS HORIZONTAL CABLING for additional VHA wire and cable standards and installation requirements. Each wire and cable used in the System shall be specifically OEM certified by tags on each reel and recommended and approved for installation in the Facility. The Contractor shall provide the RE a 610 mm (2 foot) sample of each wire and/or cable actually employed in the System and each certification tag for approval before continuing with the installation as described herein.

2.6 INSTALLATION KIT

The kit shall be provided that at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or wiring block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the RE all unused and partially opened installation kit boxes, coaxial cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, 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 are the minimum required installation sub-kits:

A. System Grounding:

1. The grounding kit shall include all cable and installation hardware required. All A/V nurse call equipment shall be connected to earth ground via internal building wiring, according to the NEC.
2. This includes, but is not limited to:
 - a. Data Cable Shields
 - c. Equipment Racks
 - d. Equipment Cabinets
 - e. Conduits
 - f. Cable Duct

- g. Cable Trays
 - h. Power Panels
 - i. Connector Panels
- B. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, wiring blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
- C. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
- F. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface Systems and sub-systems according to the OEM requirements and this document.
- G. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each sub-system according to the OEM requirements, record drawings, and this document.
- H. 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.

2.6 LIGHT AND TONE CALL INITIATION, ANNUNCIATION AND RESPONSE

- A. Calls may be initiated through:
- 1. Patient station.
 - 2. Staff station.
 - 3. Code Blue station.
 - 4. Toilet Emergency Station pull cord.
 - 5. Shower Emergency Station pull cord.
 - 6. Emergency Stations.
 - 7. Dual Code Blue/Staff Emergency Stations.
 - 8. Bed Pillow speaker.
 - 9. Bed Push-button cordset.
 - 10. Auxiliary Jack input.

- B. Once a call is initiated, it must be annunciated at the following locations:
 - 1. The Corridor, Intersectional and Room dome light associated with the initiating device.
 - 2. A local nurse station annunciator indicating the call location and priority.
 - 3. Any duty stations associated with the unit.
- C. All calls must be displayed until they are cleared by the nursing staff only from the initiating device location.

2.7 REPORTS

- A. The systems generated reports logging all calls, alarms, response time, bed, and staff assignments may be allowed to transmit these reports to a central archiving entity.
- B. Reports function shall be limited by passwords and security tier level access, so that only supervisors may access it when desired.
- C. Provide instructions to the owner on how to enable/disable the reporting functions.
- D. The Facility's LAN/WAN is not allowed for Nurses Call/Code Blue main wiring that must be a "stand alone primary cable infrastructure." Connections to the VA LAN/WAN will be allowed only when the system has been demonstrated and certified by 0050P2B meeting the minimum guidelines and requirements of Paragraph 2.4A.

2.11 MANAGEMENT SOFTWARE

The System must be able to support management software on owner-provided computers. The management software shall at a minimum provide all historical reporting features of the system as well as real-time monitoring of events. The system at this time will not be networked to provide this feature but must have the option for the future.

2.12 SYSTEM FUNCTIONAL STATIONS

- A. Duty:
 - 1. Light and Tone Only.
 - 2. Provide 1 spare station for each 20 stations installed. (Minimum 1 station)
- B. Emergency:
 - 1. Light and Tone Only.
 - 2. Provide 1 spare station for each 20 stations installed. (Minimum 1 station)
- A. Toilet emergency:

1. Light and Tone Only.
2. Provide 1 spare station for each 20 stations installed. (Minimum 1 station)

2.13 SYSTEM CONDUIT

- A. The nurse call system is NFPA listed as Emergency and Public Safety Communication System which requires the entire system to be installed in a separate conduit system.
- B. The use of centralized mechanically partitioned wireways may be used to augment main distribution conduit on a case by case basis when specifically approved by VA Headquarters (0050P3B).

2.14 DEVICE BACKBOXES

- A. The Electrical Contractor shall supply all standard backboxes required for the Nurse Call devices.
- B. The Electrical Contractor shall install the standard backboxes and specialty backboxes provided by the Nurse Call Contractor as well as the system conduit. Coordinate the delivery of the backboxes with the construction schedule.

PART 3 - EXECUTION

- 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.

3.1 INSTALLATION

- A. Product Delivery, Storage and Handling
 1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name, equipment model and serial identification numbers, and UL logo. The RE may inventory the nurse call equipment at the time of delivery and reject items that do not conform to this requirement.

2. Storage and Handling: Store and protect equipment in a manner that will preclude damage as directed by the RE.

B. System Installation

1. Do not install nurse call and fire alarm systems in the same conduit, raceway or cable trays.
2. For VA Facilities, it is permissible to include non-powered RED and MATV cables with nurse call cables provided each signal is directly controlled by its system and each cable is 100% shielded and bundled as described herein.
3. The Contractor shall provide suitable filters, traps and pads for minimizing interference and for balancing the amplifiers and distribution system(s). Items used for balancing and minimizing interference shall be able to pass audio, data and control signals in the speeds and frequency bands selected, in the directions specified, with low loss, and high isolation and with minimum delay of the system poling or subcarrier frequency(s).
4. Back up power supplies (e.g., batteries, UPS) are existing provided under Phase 1. Expand if necessary for additional stations to be installed under subsequent phases. Expansion power supplies shall be installed in the central equipment cabinet or in a separate metal cabinet equipped with a hinged door and lock. If a separate cabinet is installed, it shall be provided adjacent to the central equipment cabinet. Where the backup power supply is already self-contained in a housing, the unit can be mounted adjacent to the respective equipment cabinet. In all cases, backup power supplies must be permanently mounted. Each UPS and/or backup power supply shall be provided with full electrical supervision as described herein.
5. When prefabricated bedside units (PBPU) are used in the System, the Contractor shall contact the RE who in turn will contact the PBPU OEM to obtain proper authorizations and written certifications to attach system components to the PBPU in locations where standard PBPU access, port knockouts or routes have not been provided. Additionally, if the patient pillow speaker or cordset hanger does not have a standard place or mode of attachment to the PBPU, the Contractor shall obtain the aforementioned guidance from the PBPU OEM for attaching the hanger. Under no circumstance shall the Contractor modify, drill, punch, or proceed with installation of the System in PBPU's without the required approvals.

6. In those areas where special beds are to be used, such as Hill Rom, Striker, etc., and the communications connected to the PBPU or to the headwall, the PBPU, nurse call, and the bed OEMs shall be contacted by the RE to secure the proper authorizations and guidance for interfacing the bed's communications systems with the System.
7. All passive equipment shall be connected according to the OEM's specifications to insure correct termination, isolation, impedance match, and signal level balance at each speaker.
8. Install all equipment for each location specified herein and as identified on the drawings.
9. All trunk, distribution and interconnecting lines shall be terminated in a suitable manner to facilitate future expansion of the System by adding center terminal equipment only.
10. All vertical and horizontal lines shall be terminated so that subsequent expansion for additional audio channels shall require modifications of the System central terminal equipment only.

B. Conduit and Signal Ducts:

1. Conduit:

- a. The Contractor shall employ the latest installation practices and materials. The minimum conduit size shall be 25 mm (1 inch) in diameter for primary signal distribution and 19 mm (3/4 inch) for remote connections (i.e. dome lights, emergency station, TV control, RED control, etc.).
- b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow nurse call cables to be installed in partitioned cable tray with RED and MATV cables, shall be granted in writing by the RE if requested.) The mixing of nurse call and fire alarm cables and/or systems is not authorized and will not be approved. (See caution identified in paragraph 3-1b.3.e.). Conduit shall be provided in accordance with Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, at a minimum.
- c. Conduit fill shall not exceed 40 percent.
- d. Cable runs shall be splice free between conduit junction and interface boxes and equipment locations.
- e. Employ temporary guides, sheaves, rollers, and other necessary items to protect the wire or cable from excess tension or damaging bending during installation. Abrasion to wire or cable

jackets is not acceptable and will not be allowed. Replace all cables whose jackets has been abraded the discovery of any abraded and/or damaged cables during the proof of performance test shall be grounds for declaring the entire system unacceptable and the termination of the proof of performance test. Completely cover edges of wire or cable passing through holes in chassis, cabinets or racks, enclosures, pull or junction boxes, conduit, etc., with plastic or nylon grommetting.

- f. All cable junctions and taps shall be accessible. Do not install junction blocks, multi distribution connections or other distribution equipment (active or passive) items inside signal ducts. Use a 150 mm x 150 mm x 100 mm (6 inch x 6 inch x 4 inch) minimum covered junction box attached to the signal duct fixed side for distribution system passive equipment installation. Ensure all equipment and connection assembly junctions are accessible.

C. Distribution System Signal Wires and Cables

- 1. Wires and cables shall be provided in the same manner and use like construction practices as Fire Protective and other Emergency Systems that are identified and outlined in NFPA 101, Life Safety Code, Chapters 7, 12, and/or 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions. The wires and cables shall be able to withstand adverse environmental conditions location without deterioration. Wires and cables shall enter each equipment enclosure, console, cabinet, or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
- 2. Routing and Interconnection:
 - a. Wires or cables routed between consoles, cabinets, racks, and other equipment shall be installed in an approved conduit, signal duct, cable duct, or cable tray that is secured to building structure.
 - b. Wires and cables shall be insulated to prevent contact with signal or current carrying conductors and be 100% shielded. Wires or cables used in assembling consoles, panels, equipment cabinets and racks shall be formed into harnesses that are bundled and tied. Harnessed wires or cables shall be combed straight, formed

and dressed in either a vertical or horizontal relationship to equipment, controls, components or terminations.

- c. Harnesses with intertwined members are not acceptable. Each wire or cable that breaks out from a harness for connection or termination shall have been tied off at that harness or bundle point, and provided with a neatly formed service loop.
- d. Wires and cables shall be grouped according to service (i.e.: AC, grounds, signal, DC, control, etc.). DC, control and signal cables may be included with any group. Wires and cables shall be neatly formed and shall not change position in the group throughout the conduit run. Wires and cables in approved signal duct, conduit, cable ducts, or cable trays shall be neatly formed, bundled and tied off in 600 mm to 900 mm (24 to 36 inch) lengths and shall not change position in the group throughout the run. Concealed splices are not allowed.
- e. Separate, organize, bundle, and route wires or cables to restrict channel crosstalk or feedback oscillation inside any enclosure. Looking at any enclosure from the rear (wall mounted enclosures, junction, pull or interface boxes from the front), locate AC power, DC, and speaker wires or cables on the left; coaxial, control, microphone, and line level audio and data wires or cables, on the right. This installation shall be accomplished with ties and/or fasteners that will not damage or distort the wires or cables. Limit spacing between tied off points to a maximum of 150 mm (6 inches).
- f. Distribution cables shall be installed and fastened without causing sharp bends or rubbing of the cables against sharp edges. Cables shall be fastened with hardware that will not damage or distort them.
- g. Cables shall be labeled with permanent markers at the terminals of the electronic and passive equipment and at each junction point in the System. The lettering on the cables shall correspond with the lettering on the record diagrams.
- h. Completely test all of the cables after installation and replace any defective cables.
- i. Provide system input and output polarity as recommended by the OEM. Insure each color coded wire or cable is connected and terminated to maintain system polarity to be at least the same

quality of professional audio systems. Reflect all color codes, wire and cable terminations on the System's record drawings as required herein.

D. Outlet Boxes, Back Boxes, and Face Plates

1. Outlet Boxes: Signal, power, interface, connection, distribution, and junction boxes shall be provided as required by the system design, on-site inspection, and review of the contract drawings.
2. Back Boxes: Back boxes shall be provided as directed by the OEM as required by the approved system design, on-site inspection, and review of the contract drawings.
3. Face Plates (or Cover Plates): Face plates shall be of a standard type, stainless steel, anodized aluminum or UL approved cyclolac plastic construction and provided by the Contractor for each identified system location. Connectors and jacks appearing on the face plate shall be clearly and permanently marked.

E. Connectors: Circuits, transmission lines and signal extensions shall have continuity, correct connection, and polarity. Polarity shall be maintained between all points in the System.

1. Wires:

- a. Wire ends shall be neatly formed and where insulation has been cut, heat shrink tubing shall be employed to secure the insulation on each wire. Tape of any type is not acceptable and will not be approved.
 - b. Audio spade lugs shall be installed on each wire (including spare or unused) end and connect to screw terminals of appropriate size barrier strips. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current. Wiring blocks are approved for signal, not AC wires. Wire Nut or "Scotch Lock" connectors are not acceptable for signal wire installation.
2. Cables: Each connector shall be designed for the specific size cable being used and installed with the OEM's approved installation tool. Typical system cable connectors include; but, are not limited to: Audio spade lug, wiring block, wirewrap, etc.

F. AC Power: AC power wiring shall be run separately from signal cable.

G. Grounding:

1. General: The Contractor shall ground all Contractor installed equipment to eliminate all shock hazard and to minimize, to the

maximum extent possible, all ground loops, common mode returns, noise pickup, crosstalk, etc. The total ground resistance shall be 0.1 Ohm or less:

- a. Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, subcarrier or audio reference ground.
 - b. The use of conduit, signal duct, or cable trays as system or electrical ground is not acceptable and will not be permitted. These items may be used only for the dissipation of internally generated static charges [not to be confused with externally generated lightning] that may be applied or generated outside the mechanical and/or physical confines of the System to earth ground. The discovery of improper system grounding shall be grounds to declare the System unacceptable and the termination of all system acceptance testing.
3. Cabinet Buss: A common ground buss of at least #10 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground. Provide a separate isolated ground connection from each equipment cabinet ground buss to the system ground. Do not tie equipment ground busses together.
 4. Equipment: Equipment shall be bonded to the cabinet ground bus with copper braid equivalent to at least #12 AWG. Self grounding equipment enclosures, racks or cabinets, that provides OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternates.
 5. Cable Shields: Cable shields shall be bonded to the cabinet ground buss with #12 AWG minimum stranded copper wire at only one end of the cable run. Cables shields shall be insulated from each other, face plates, equipment racks, consoles, enclosures or cabinets; except, at the system common ground point. Coaxial and audio cables, shall have one ground connection at the source; in all cases, cable shield ground connections shall be kept to a minimum.

H. Equipment Assembly:

1. Cabinets:
 - a. Each enclosure shall be: wall mounted with standard knockout holes for conduit connection or cable entrance; provide for ventilation of the equipment; have front and rear locking doors

- (except wall mounted cabinets that require only a front locking door); power outlet strip(s) and bulkhead connector panel(s).
- b. Enclosures shall be installed plumb and square. Each shall be permanently attached to the building structure and held firmly in place as approved by the RE.
 - c. Signal equipment, patch or bulkhead connector panels (i.e.: audio, data, control, etc.) shall be connected so that output for from each source, device or system component shall enter the panel at the top row of jacks, beginning left to right as viewed from the front, which will be called "input". Each connection to a load, device or system component shall exit the panel at the bottom row of jacks, beginning left to right as viewed from the front, which will be called "output".
 - d. Labeling: Abbreviations may be used as long as they are symbol(s) or acronyms designated for the System or equipment by accepted industry standards and each abbreviation is used on the appropriate system and sub-system "record" drawing.
 - 1. Cable and Wires (Hereinafter referred to as "Cable"): The Contractor shall install labels on all cables at each side of all connections. The labeling shall be permanent, with contrasting identification alpha or numeric, identifying each cable according to the System "as record" drawings. Labels shall be installed adjacent to each mechanical connector, pull box or break in the cable run.
 - 2. Equipment: The Main Nurse Call Control Panel, amplifying, control, switching, and routing equipment inputs and outputs shall be permanently labeled with contrasting plastic laminate or bakelite material. System equipment shall be permanently labeled on the face of the unit corresponding to its source. Remote control equipment shall be labeled according to the unit or system being controlled. Equipment labels shall be permanently affixed to the equipment with metal screws, permanent mounting devices or cement.
 - 3. AC Power: The AC Power Panel Directory shall identify which equipment console, cabinet or enclosure that it serves. Each equipment console, cabinet or enclosure shall be labeled to identify which AC power panel provides power to it. These labels shall be permanently affixed to the equipment with metal screws, permanent mounting devices or cement.

4. 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 every 3 meters (10 feet) identifying it as the System. Also, each enclosure shall be labeled according to this standard.

3.2 COORDINATION WITH OTHER TRADES

- A. Before beginning work, verify the location, quantity, size and access for the following:
 1. Isolated ground AC power circuits provided for systems.
 2. Primary, emergency and extra auxiliary AC power generator requirements.
 3. Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.
 4. System components installed by others.
 5. Overhead supports and rigging hardware installed by others.
- B. Immediately notify the Owner, General Contractor and Consultant in writing of any discrepancies.

3.2 PROOF OF PERFORMANCE TESTS

- A. Intermediate Testing:
 1. After completion of the installation of a central control cabinet and equipment, nurse station annunciator, local and remote Stations, this portion of the System must be pretested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed, NFPA, Life Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.
 2. The inspection and test will be conducted by a factory-certified representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by the Government Representative and maintained on file by the 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 - 80% point of the system construction phase, at the direction of the RE.

B. Pretesting:

1. Upon completing installation of the System, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
2. Pretesting Procedure:
 - a. During the System pretest the Contractor shall verify (utilizing approved spectrum analyzer and test equipment) that the System is fully operational and meets all the System performance requirements of this standard.
 - b. The Contractor shall pretest and verify that all system functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. At a minimum, each of the following locations shall be fully pretested:
 - 1) Central Control Cabinets
 - 2) Nurse Control Stations
 - 3) Duty Stations
 - 4) Emergency Stations
 - 5) System trouble reporting
 - 6) UPS operation
3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.

C. Acceptance Test:

1. After the System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 30 days written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of a Government Representative and an OEM certified representative. The System shall be tested utilizing the approved test equipment to certify proof of performance and Life Safety compliance. The test shall verify that the total System meets 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 effect repairs, shall cause the entire System to be declared unacceptable. Retesting of the entire System shall be rescheduled at the convenience of the Government.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:

- a. The Government Representative will tour all major areas where the System is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
- b. The System diagrams, record drawings, equipment manuals, AutoCAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
- c. Failure of the System to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test:

- a. After the Physical and Mechanical Inspection, the central control equipment and nurse station annunciator shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be
- b. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last intersectional, room, and bed dome light in each leg to verify that the nurse call distribution system meets all system performance standards.

- c. Additionally, each installed emergency, duty, intersectional, room, and bed dome light, power supply, and remote annunciator panels 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: nurse follower, three levels of emergency signaling (i.e. flashing red emergency, flashing white patient emergency, flashing white or combination lights for staff emergency, separate flashing code blue), minimum of ten minutes of UPS operation, memory saving, minimum of ten station audio paging, canceling emergency calls at each originating station only, and storage and prioritizing of calls.
 - g. Individual Item Test: The Government 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 born by the Contractor.

3.3 TRAINING

- A. Furnish the services of a factory-trained engineer or technician for four eight-hour periods to instruct the Facility's maintenance personnel. Instruction shall include corrective and preventive maintenance of the nurse call equipment. Training shall be accomplished before the VA can accept the System. Additionally, training will be scheduled at the convenience of the Facility's, Chief Engineering Service.
- B. Furnish the services of a representative of the nurse call and code blue OEM, familiar with the functions and operation of the equipment, for two eight-hour periods to train nursing personnel. Instructions

shall be provided for staff personnel in each ward where new nurse call and code blue equipment is provided under this contract. When multiple wards are involved, classes will be grouped. Periods of training shall be coordinated with the Chief of Nursing Service for the Facility to ensure all nursing shifts receive the required training. Each session shall include instructions utilizing a factory prepared and RE approved vertical - horizontal system (VHS) format video tape presentation and "hands-on" operation of the nurse call and code one (blue) equipment on a hospital ward. The tape presentation shall be sufficient in detail to stand-alone as a training aid for initial utilization and familiarization of the System. Additionally, the Contractor shall provide two (2) copies of the video presentation to the Chief of Nursing Service.

3.4 GUARANTEE PERIOD OF SERVICE

A. Contractor's Responsibility:

1. The Contractor shall guarantee that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the System by the VA. The Contractor shall provide OEM's equipment warranty documents, to the 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 one year guaranty period.

B. Response Time During the One Year Guaranty Period:

1. The RE or Facility Contracting Officer is the Contractor's 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., Monday through Friday exclusive of Federal Holidays.
 3. The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
 - a. A routine trouble call within one working day of its report. A routine trouble is considered a trouble which causes a pillow speaker or cordset, master nurse control station, patient station, emergency station, or dome light to be inoperable.
 - b. An emergency trouble call within four hours of its report. An emergency trouble is considered a trouble which causes a sub-system (ward), distribution point, terminal cabinet, or Code Blue system to be inoperable at anytime.
 4. If a nurse call and/or code blue component failure cannot be corrected within four hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate nurse call equipment. The alternate equipment/system shall be operational within a maximum of four hours after the four 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.
 5. Routine trouble calls in critical emergency health care facilities (i.e., emergency department, 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. Required On-Site Visits During the One Year Guaranty Period
1. The Contractor shall visit, on-site, for a minimum of eight 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 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 guarantee period to RE or Facility Contracting Officer by the fifth working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.
 - b. 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 COTR 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.
- D. 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 findings concerning any Contractor's responsibility.

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SECTION 28 05 11
REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section, Requirements for Electronic Safety and Security Installations, applies to all sections of Division 28.
- B. Furnish and install electronic safety and security cabling, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of, 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 four 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 Section 00 72 00, 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 or COTR, 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 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 Section 00 72 00, 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.
 - 2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
 - 3. 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. Conduit hangers, clamps and supports.
 4. Duct sealing compound.

I. In addition to the requirement of SUBMITTALS, the VA reserves the right to request the manufacturer to arrange for a VA representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.

1.11 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 COTR or the Resident Engineer at least 30 days prior to the planned training.

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SECTION 28 05 13
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of the conductors and cables for electronic safety and security.

1.2 RELATED WORK

- A. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- B. General electrical requirements that are common to more than one section in Division 28: Section 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.
- C. Conduits for cables and wiring: Section 28 05 33, RACEWAYS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY.

1.3 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
1. Manufacturer's Literature and Data: Showing each cable type and rating.
 2. Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):
D2301-04.....Standard Specification for Vinyl Chloride
Plastic Pressure Sensitive Electrical Insulating
Tape
- C. Federal Specifications (Fed. Spec.):
A-A-59544-00.....Cable and Wire, Electrical (Power, Fixed
Installation)
- D. National Fire Protection Association (NFPA):
70-05.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

- 44-02.....Thermoset-Insulated Wires and Cables
- 83-03.....Thermoplastic-Insulated Wires and Cables
- 467-01.....Electrical Grounding and Bonding Equipment
- 486A-01.....Wire Connectors and Soldering Lugs for Use with
Copper Conductors
- 486C-02.....Splicing Wire Connectors
- 486D-02.....Insulated Wire Connector Systems for Underground
Use or in Damp or Wet Locations
- 486E-00.....Equipment Wiring Terminals for Use with Aluminum
and/or Copper Conductors
- 493-01.....Thermoplastic-Insulated Underground Feeder and
Branch Circuit Cable
- 514B-02.....Fittings for Cable and Conduit
- 1479-03.....Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.1 CONTROL WIRING

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.2 COMMUNICATION AND SIGNAL WIRING

- A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.
- B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.
- C. Multi-conductor cables shall have the conductors color coded.

2.3 WIRE LUBRICATING COMPOUND

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

2.4 FIREPROOFING TAPE

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.

- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Splice cables and wires only in outlet boxes, junction boxes, or pull boxes.
- B. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- C. Wire Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - 2. Use ropes made of nonmetallic material for pulling feeders.
 - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer.
 - 4. Pull in multiple cables together in a single conduit.

3.2 INSTALLATION IN MANHOLES

- A. Install and support cables in manholes on the steel racks with porcelain or equal insulators. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.
- B. Fireproofing:
 - 1. Install fireproofing where low voltage cables penetrate any Fire Rated wall with an approved UL listed Through Penetration Firestop System

3.3 SPLICE INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure.
- B. 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.

3.4 CONTROL, COMMUNICATION AND SIGNAL WIRING INSTALLATION

- A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.

- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

3.5 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.5 EXISTING WIRING

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.

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SECTION 28 05 26
GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies general grounding and bonding requirements of electronic safety and security installations for equipment operations.
- 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 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 28.
- B. Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY: Low Voltage power and lighting wiring.
- C. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for a lightning protection system.

1.3 SUBMITTALS

- A. Submit in accordance with Section 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY 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. 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.

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 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.

2.5 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 ¾ inch).

2.6 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.

2.7 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.

2.8 COMPUTER ROOM GROUND

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.

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 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.

3.4 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.
- 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.

3.5 COMPUTER 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. Bond every metallic conduit that penetrates the plan of the raised floor to the raised floor stringer system as follows:
 - a. Unpainted Supports Attached to Raised Floor System: When conduit/strut clamps are used to attach conduit to Unistrut, no additional bonding is required.
 - b. Unpainted Supports Not Attached to Raised Floor System: When conduit/strut clamps are used to attach conduit to Unistrut, use 16 mm² (6 AWG) bonding jumpers to connect Unistrut to the raised floor system.

- c. Painted Supports: Use 16 mm² (6 AWG) bonding jumpers to connect conduit to the stringer system. Mount a push-type conduit fastener onto every metallic conduit. Place fasteners no higher or lower than 75 mm (3 inches) from the raised floor stringer.

B. Equipotential Grounding Grid:

1. Install a bolted stringer system to serve as the computer room equipotential grounding grid.
2. If a bolted stringer system is not provided, install equipotential grounding grid in a 600 mm square grid consisting of 50 mm² (1/0 AWG) bare copper conductor welded at the intersection of each grid.
3. Attach the equipotential ground grid to the room signal ground bus using a 50 mm² (1/0 AWG) bare copper grounding conductor.

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 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.

3.8 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.

3.9 GROUNDING FOR RF/EMI CONTROL

- A. Install bonding jumpers to bond all conduit, cable trays, sleeves and equipment for low voltage signaling and data communications circuits. Bonding jumpers shall consist of 100 mm (4 inches) wide copper strip or two 6 mm² (10 AWG) copper conductors spaced minimum 100 mm (4 inches) apart. Use 16 mm² (6 AWG) copper where exposed and subject to damage.
- B. Comply with the following when shielded cable is used for data circuits.
 - 1. Shields shall be continuous throughout each circuit.
 - 2. Connect shield drain wires together at each circuit connection point and insulate from ground. Do not ground the shield.
 - 3. Do not connect shields from different circuits together.
 - 4. Shield shall be connected at one end only. Connect shield to signal reference at the origin of the circuit. Consult with equipment manufacturer to determine signal reference.

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SECTION 28 05 33
RACEWAYS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY

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 electronic safety and security cabling unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

- A. Mounting board for communication closets: Section 06 10 00, ROUGH CARPENTRY.
- B. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- C. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- D. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.
- E. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- F. General electrical requirements and items that is common to more than one section of Division 28: Section 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.
- G. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY.

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 main feeders;
 - 2. Size and location of panels and pull boxes
 - 3. Layout of required conduit penetrations through structural elements.
 - 4. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Certification: Prior to final inspection, deliver to the Resident Engineer 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. 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. Surface metal raceway fittings: As recommended by the raceway manufacturer.
- 7. 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 or COTR as required by limited working space.
- B. Fire Stop: Where conduits, wireways, and other electronic safety and security raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

- A. Install conduit as follows:
1. In complete runs before pulling in cables or wires.

2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
 3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
 5. Mechanically continuous.
 6. Independently support conduit at 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:
1. Install conduit with wiring, including homeruns, as shown.
 2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COTR.
- D. Fire Alarm:
1. Fire alarm conduit shall be painted red (a red "top-coated" conduit from the conduit manufacturer may be used in lieu of painted conduit)

in accordance with the requirements of Section 28 31 00, Fire Detection and Alarm.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only when the following occurs:
 - a. Where shown on the structural drawings.
 - b. As approved by the Resident Engineer 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.

3.5 EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.
- D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction

boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

3.6 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
 - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.7 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush mounted.

2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes.)
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with black marker.

3.12 ELECTRONIC SAFETY AND SECURITY CONDUIT

- A. Install the electronic safety and security raceway system as shown on drawings.
- B. Minimum conduit size of 19 mm (3/4 inch), but not less than the size shown on the drawings.
- C. All conduit ends shall be equipped with insulated bushings.
- D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.
- E. Vertical conduits/sleeves through closets floors shall terminate not less than 75 mm (3 inches) below the floor and not less than 75 mm (3 inches) below the ceiling of the floor below.
- F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.
- G. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.
- H. All empty conduits located in communications closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- I. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
$\frac{3}{4}$	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

- J. Furnish and install 19 mm (3/4 inch) thick fire retardant plywood specified in on the wall of communication closets where shown on drawings . Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.
- K. Furnish and pull wire in all empty conduits. (Sleeves through floor are exceptions).

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SECTION 28 13 11
PHYSICAL ACCESS CONTROL SYSTEM (PACS)

PART 1 - GENERAL

1.1 DESCRIPTION

Provide and install new doors on the existing Physical Access Control System installed under Project Number 06-106. The Physical Access Control System hereinafter shall be referred to as the PACS.

1.2 RELATED WORK

- A. For firestopping application and use, Section 07 84 00, FIRESTOPPING.
- B. For labeling and signs, Section 10 14 00, SIGNAGE.
- C. For connection of high voltage, Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- D. For power cables, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- E. For grounding of equipment, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- F. For infrastructure, Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
- G. For infrastructure, Section 26 05 36, CABLE TRAYS FOR ELECTRICAL SYSTEMS.
- H. For Installation, Section 28 05 11, Requirements for Electronic Safety and Security Installations.
- I. For Installation, Section 28 05 13, Conductors and Cable for Electronic Safety and Security Installations.
- J. For Installation, Section 28 05 26, Grounding and Bonding for Electronic Safety and Security Installations.
- K. For control and operation of all security systems, Section 28 13 16, ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT.
- L. For Warranty of Construction, Section 00 72 00, GENERAL CONDITIONS.
- M. For General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

1.3 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the Access Control System as shown. The Contractor shall also provide certification as required.
- B. The Access Control 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. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

1.4 SUBMITTALS

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, and Section 02 41 00, DEMOLITION.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a complete and thorough pre-installation and as-built design package in both electronic format, AutoCAD format and on paper, minimum size 42 X 30 inches (Architectural E1); drawing submittals shall be per the established project schedule.
- D. Pre-installation design and as-built packages shall include, but not be limited to:
 - 1. Index Sheet that shall:
 - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
 - b. Provide a 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.
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/ Security Industry Association (SIA):
 - AC-01.....Access Control: Wiegand Card Reader Interface Standard
 - AC-03.....Access Control: Badging Techniques
- C. American National Standards Institute (ANSI)/ International Code Council (ICC):
 - A117.1.....Standard on Accessible and Usable Buildings and Facilities
- D. Department of Justice American Disability Act (ADA)
 - 28 CFR Part 36-90.....ADA Standards for Accessible Design
- E. Government Accountability Office (GAO):
 - GAO-03-8-02.....Security Responsibilities for Federally Owned and Leased Facilities
- F. National Electrical Contractors Association

303-2005.....Installing Closed Circuit Television (CCTV)
Systems

G. National Electrical Manufacturers Association (NEMA):

250-03.....Enclosures for Electrical Equipment (1000 Volts
Maximum)

H. National Fire Protection Association (NFPA):

70-05..... Article 780-National Electrical Code

I. Underwriters Laboratories, Inc. (UL):

294-99.....Standard for Access Control

305-97.....Standard for Panic Hardware

639-97.....Standard for Intrusion-Detection Units

752-05.....Standard for Bullet-Resisting Equipment

827-96.....Central Station Alarm Services

1076-95.....Standards for Proprietary Burglar Alarm Units
and Systems

1981-03.....Central Station Automation System

2058-05.....High Security Electronic Locks

J. Homeland Security Presidential Directive (HSPD):

HSPD-12.....Policy for a Common Identification Standard for
Federal Employees and Contractors

K. Federal Information Processing Standards (FIPS):

FIPS-201.....Personal Identity Verification (PIV) of Federal
Employees and Contractors

L. National Institute of Standards and Technology (NIST):

IR 6887 V2.1.....Government Smart Card Interoperability
Specification (GSC-IS)

Special Pub 800-96.....PIV Card Reader Interoperability Guidelines

M. Institute of Electrical and Electronics Engineers (IEEE):

C62.41.....IEEE Recommended Practice on Surge Voltages in
Low-Voltage AC Power Circuits

N. International Organization for Standardization (ISO):

7810.....Physical Characteristics of Credit Card Size
Document

7811.....Physical Characteristics for Magnetic Stripe
Cards

7816-1.....Physical Characteristics of the Card

7816-2.....Dimensions and Contact Position of the card

7816-3.....Electrical Signals and Transmission Protocols

7816-4.....Inter-Industry Command for Interchange
14443.....RFID cards; Contactless Proximity Cards
Operating at 13.56 MHz in up to 5 inches
distance
15693.....RFID cards; Contactless Vicinity Cards
Operating at 13.56 MHz in up to 50 inches
distance

O. Uniform Federal Accessibility Standards (UFAS) 1984

P. ADA Standards for Accessible Design 1994

1.6 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. Provide final As Built drawings to COTR in AutoCAD 2007 Format.
- B. The floor plans shall be marked in pen to include the following:
1. All device locations with labels.
 2. Conduit locations.
 3. Head-end equipment and specific location.
 4. Wiring diagram.
 5. Labeling and administration documentation.
 6. Warranty certificate.
 7. System test results.

1.7 WARRANTY OF CONSTRUCTION.

Warrant PACS work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. All equipment associated within the PACS shall be UL 294 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 96 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 easy of operation, programming, servicing, maintenance, testing, and upgrading of the system.
- D. All PACS 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 NFPA 70, Chapter 5.
- E. All equipment and materials for the system will be compatible to ensure correct operation as outlined in FIPS 201, March 2006 and HSPD-12.

2.2 EQUIPMENT ITEMS

- A. 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.
- B. PACS equipment shall meet or exceed all requirements listed below.
- C. A PACS shall be comprised of, but not limited to, the following components:
 - 1. Control/Communications Panel
 - 2. Electronic Security Management System Interface
 - 3. Card Reader and Credential Cards
 - 4. Scramblepad Keypad.
 - 5. Biometrics
 - 6. Portal Control Devices
 - 7. Door Status Indicators
 - 8. Entry Control Device
 - 9. Local Door Alarm Indicator
 - 10. Police Alarm Buttons
 - 11. Police Alarm Panic Buttons
 - 12. Power Supplies
 - 13. Conduit
 - 14. Wires and Cables
- D. Control/Communication Panel:
 - 1. Added Equipment shall be of the same manufacturer and part number as the existing system installed under Physical Security Upgrade Project# 06-106, to ensure full compatibility within the system.
 - 2. The Door Control Module:

The existing M8N Door controllers located in the interstitial space shall be relocated to the signal closet on the First Floor as shown and reinstalled. The existing Door Controllers provide these existing features:

- a. Control up to 8 doors utilizing input and output relays that are fully programmable via network software.
- b. Input relays shall meet the following minimum requirements:
 - 1) Provide up to 16 UL 1076 analog unsupervised alarm input zones to monitor and report alarm conditions, power faults, and tampers.
 - 2) Operate independently and in conjunction with output relays, which will send an output signal to a corresponding output device upon alarm input activation. Once an alarm has been received, the input relay shall activate any or all alarm outputs.
 - 3) Contain the following features:
 - a) UL 294 Certified.
 - b) Alarm contact status scanning at up to 120 times per second for each zone.
 - c) A low power Complementary-symmetry/metal-oxide semiconductor (CMOS) microprocessor.
 - d) Filtered data for noise rejection to prevent false alarms.
 - e) Up to 16 supervised inputs.
 - f) 12 VAC or 12 VDC Input Power.
 - g) Two (2) dedicated inputs for tamper and power status.
3. Output relays shall meet the following minimum requirements:
 - a. Shall be capable of controlling a corresponding output device upon any input activation or on command from the PACS.
 - b. Shall be capable of responding to:
 - 1) Input alarms.
 - 2) Commands from a System Operator.
 - 3) Time zone control commands for automatic operation.
 - c. Shall be capable of:
 - 1) Pulsing for a predetermined duration. Duration shall be programmable for each relay individually.
 - 2) Responding on command from the System Operator to pulse, command on, command off, or reset to normal state.
 - 3) Operating outputs rated at 5 amps (A) @ 30 VDC.

E. Electronic Security Management System (SMS): (Existing)

1. All additional equipment shall be compatible with the existing SMS as installed under Physical Security Upgrade Project# 06-106.

F. Card Readers and Credential Cards:

1. 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.
2. Will be fully programmable and addressable, locally and remotely, and hardwired to the system.
3. Shall be individually home run to the main panel.
4. Shall be installed in a manner that they comply with:
 - a. The Uniform Federal Accessibility Standards (UFAS)
 - b. The Americans with Disabilities Act (ADA)
 - c. The ADA Standards for Accessible Design
5. 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 compliant. The reader output can be Wiegand, RS-22, 485 or TCP/IP.
6. Are to be housed in an aluminum bezel with a wide lead-in for easy card entry.
7. Shall contain read head electronics, and a sender to encode digital door control signals.
8. LED's shall be utilized to indicate card reader status and access status.
9. Shall be able to support a user defined downloadable off-line mode of operation (e.g. locked, unlocked, or facility code), which will go in effect during loss of communication with the main control panel.
10. 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?? What does this mean) audible feedback.

11. Shall have a minimum of two programmable inputs and two programmable outputs.
12. All card readers that utilize keypad controls along with a reader and shall meet the following specifications:
 - a. 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.
 - b. 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.
 - c. 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.
 - d. Shall be powered from the source as designed and shall not dissipate more than 150 Watts.
 - e. Shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.
 - f. Shall provide a means for users to indicate a duress situation by entering a special code.
13. Card readers shall come in the following formats:
 - a. Proximity (PROX) Card Reader:
 - 1) Shall be utilized during the transition from the existing technology to the contactless smart card technology as defined in FIPS-201.

- 2) Shall use active/passive proximity detection and shall not require contact with the proximity credential card for operation.
 - a) Active detection proximity card readers shall provide power to compatible credential cards through magnetic induction and receive and decode a unique identification code number transmitted from the credential card.
 - b) Passive detection proximity card readers shall use a swept-frequency, radio frequency field generator to read the resonant frequencies of tuned circuits laminated into compatible credential cards. The resonant frequencies read shall constitute a unique identification code number.
- 3) Shall read proximity cards in a range from 0 to at least six (6) inches (0 to at least 15 cm) from the reader. The credential card design shall allow for a minimum of 32,000 unique identification codes per facility.
- 4) Shall be able to read cards from two (2) inches (5cm) to 6 inches (15cm).
- 5) For exterior parking lots or garages shall be 16 inches (40 cm).
- 6) The operating frequency shall be determined by the type of access control system being utilized.
- e. Credential Cards: Shall be in accordance with FIPS 201 and controlled by the PIV enrollment and issuance system.

G. ScramblePad Keypad:

1. The keypad shall incorporate the following features: Scrambling display of numbers 0 - 9 (numbers appear in different location every time it is used); +/- 4 degree horizontal and +/- 26 degree vertical viewing restriction; accept 3 - 15 digit CODEs simultaneously; be disabled for 1 minute and report CODE Tamper violation (guessing CODEs); be disabled and report Physical Tamper violation (attempt to remove keypad from mounting box); silent CODE duress; status LEDs for reporting granted, denied, and overridden transactions, AC Fail, Programming Mode active, responses to Status Request of Alarm Inputs and Relay Outputs; weather resistant; supervised by controller; and built-in diagnostics. The ScramblePad shall include the MATCH Reader Interface functionality for connection of up to two (2) card

readers. The scrambling keypads shall be the Hirsch ScramblePad Model DS47L & DA37L-HW.

H. Portal Control Devices:

1. Shall be used to assist the PACS.
2. Such devices shall:
 - a. Provide a means of monitoring the doors status.
 - b. Allow for exiting a space via either a push button, request to exit, or panic/crash bar.
 - c. Provide a means of override to the PACS via a keypad or key bypass.
 - d. Assist door operations utilizing automatic openers and closures.
 - e. Provide a secondary means of access to a space via a keypad.
3. Shall be connected to and monitored by the main PACS panel.
4. Shall be installed in a manner that they comply with:
 - a. The Uniform Federal Accessibility Standards (UFAS)
 - b. The Americans with Disabilities Act (ADA)
 - c. The ADA Standards for Accessible Design
5. Shall provide a secondary means of access control within a secure area.
6. Keypads: Refer to Section 2.2.F.12 for keypad requirements.
7. Push-Button Switches:
 - a. 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.
 - b. 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.
 - c. 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.
 - d. Shall have double-break silver contacts that will make 720 VA at 60 amperes and break 720 VA at 10 amperes.

8. Crash Bar:

a. Emergency Exit with Alarm (Panic):

1. Entry control portals shall include panic bar emergency exit hardware as designed.
2. Panic bar emergency exit hardware shall provide an alarm shunt signal to the PACS and SMS.
3. 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.
4. 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.
5. The panic bar shall a fully mechanical connection only and shall not depend upon electric power for operation.
6. The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt manually by either pressing the panic bar or with a key bypass. Refer to Section 2.2.I.9 for key-bypass specifications.

b. Normal Exit:

- 1) Entry control portals shall include panic bar non-emergency exit hardware as designed.
- 2) Panic bar non-emergency exit hardware shall be monitored by and report to the SMS.
- 3) Operation of the panic bar hardware shall not generate a locally audible or an intrusion alarm within the IDS.
- 4) When exiting, the panic bar shall depend upon a mechanical connection only. The exterior, non-secure side of the door shall be provided with an electrified thumb latch or lever to provide access after the credential I.D. authentication by the SMS.
- 5) The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt manually by either pressing the panic bar or with a key bypass. Refer to Section 2.2.I.9 for key-bypass specifications. The strikes/bolts shall include a micro switch to indicate to the system when the bolt is not engaged or the strike

mechanism is unlocked. The signal switches shall report a forced entry to the system in the event the door is left open or accessed without the identification credentials.

9. Key Bypass:

- a. Shall be utilized for all doors that have a mortise or rim mounted door hardware.
- b. Each door shall be individually keyed with one master key per secured area.
- c. 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.
- d. All keys shall have a serial number cut into the key. No two serial numbers shall be the same.
- e. All keys and cylinders shall be stored in a secure area that is monitored by the Intrusion Detection System.

10. Automatic Door Opener and Closer:

- a. Shall be low energy operators.
- b. Door closing force shall be adjustable to ensure adequate closing control.
- c. Shall have an adjustable back-check feature to cushion the door opening speed if opened violently.
- d. 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.
- e. 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.
- f. Door control shall be adjustable to provide compliance with the requirements of the Americans with Disabilities Act (ADA) and ANSI standards A117.1.
- g. All automatic door openers and closers shall:
 - 1) Meet UL standards.
 - 2) Be fire rated.

- 3) Have push and go function to activate power operator or power assist function.
- 4) Have push button controls for setting door close and door open positions.
- 5) Have open obstruction detection and close obstruction detection built into the unit.
- 6) 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.
- 7) 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.
- 8) 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.

J. 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 Access Control/Intrusion Detection System for all doors operated by the PACS and all other doors that require monitoring by the system.
 - c. Switches for doors operated by the PACS shall be single pole double throw (SPDT). One side of the switch shall monitor door position. 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 concealed flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).

11. Request-to-Exit (RTE):

- a. Shall be utilized to de-energize the locking hardware on a door to allow for exiting a secure area without knowledge or effort.

- b. Shall be an infrared sensor.
- c. Infrared sensors shall meet the following minimum technical characteristics:

Alarm Output	2 Form "C" relay contacts
Indicators	1 activation LED
Power Requirements	12 or 24 VAC, 12 or 24 VDC, 26 mA @ 12 VDC
Relay Latch	Time Adjustable to 60 seconds

K. Entry Control Devices:

- 1. Shall be hardwired to the PACS main control panel and operated by either a ScramblePad keypad, proximity 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 veristor (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.

L. Local Door Alarm Indicator:

1. Shall be used to assist the PACS.
2. Such devices shall:
 - a. Provide an audible means of indicating local access alarm.
 - b. Ancillary to the PACS operation and provided by output relay.

M. Power Supplies: (Existing to be relocated with door controller)

1. Shall be UL rated and able to adequately power two entry control devices on a continuous base without failure.
2. Shall meet the following minimum technical characteristics:

INPUT POWER	110 VAC 60 HZ 2 amp
OUTPUT VOLTAGE	12 VDC Nominal (13.8 VDC) 24 VDC Nominal (27.6 VDC) Filtered and Regulated
BATTERY	Dependant on Output Voltage shall provide up to 14 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

N. Wires and Cables

1. Shall meet or exceed the manufactures recommendations for power and signal.
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 clearly marked every with colored permanent tape or paint that will allow it to be distinguished from all other conduit and infrastructure.
5. Conduit fills shall not exceed 50 percent unless otherwise documented.

6. A pull rope shall be pulled along with signal and power cables to assist in future work.
7. At all locations where core drilling is conducted to allow for conduit to be installed, then fire stopping shall be applied to that area.
8. High power and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High power for the security system shall be defined as any cable or sets of cables carrying 30 VDC/VAC or higher.
9. Signal Cables:
 - a. Shall meet or exceed all specifications and requirements called out by the manufactures.
 - b. Shall be twisted pairs.
 - c. All cables and conductors, except fiber optic cables, that act as a control, communication, or signal lines shall include surge protection. Surge protection shall be furnished at the equipment end and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within 3 feet, (1 meter) of the building cable entrance. The inputs and outputs shall be tested in both normal and common mode using the following wave forms:
 - 1) A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and peak current of 60 amperes.
 - 2) An 8 microsecond rise time by 20 microsecond pulse width wave form with a peak voltage of 1000 volts and peak current of 500 amperes.
10. Power Cables:
 - a. Shall be rated for either 110 or 220 VAC, 50 or 60 Hz, and shall comply with VA Master Spec 26 05 21 Low Voltage Electrical Power Conductors and Cables (600 Volts and Below).
 - b. Shall be sized according and comply with the NEC. High voltage power cables will be a minimum of three conductors, 14 AWG, stranded, and coated with a non-conductive polyvinylchloride (PVC) jacket.
 - c. Low Voltage Power Cables:
 - 1) All cables shall be a minimum of 18 AWG, Stranded and have a polyvinylchloride outer jacket.

2) Specific cable size shall be determined using a basic voltage over distance calculation and shall comply with the NEC's requirements for low voltage cables.

d. All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used as a means of surge protection.

2.3 INSTALLATION KIT

A. 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. 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 outlined are the minimum required installation sub-kits:

1. 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.

1. 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) Control Cable Shields
- 2) Data Cable Shields
- 3) Equipment Cabinets
- 4) Conduits
- 5) Power Panels
- 6) Grounding

7) Connector Panels

3. 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.
4. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
5. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
6. 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.
7. 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

3.1 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, existing 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 the existing network and all associated security subsystems, whether the system is a stand alone or a network.

- E. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.
- F. 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.
- G. 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.
- H. Existing Equipment:
 - 1. The Contractor shall connect new doors to the existing Door Controllers and Power Supplies relocated during Phase 1.
 - 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.

- J. Enclosure Penetrations: All enclosure penetrations shall be from the top 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.
- K. 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.
- L. 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.
- M. SMS:
1. Configure the new control panel to interface with the existing Security Management System installed under Physical Security Upgrade Project# 06-106.
- N. Scramblepad:
1. Connect all signal input and output cables along with all power cables.
 2. Program and ensure the device is in operating order.
- 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. 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.
- Q. 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 concealed flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).

R. 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.

S. Local Door Alarm Indicators:

1. Install all signal input and output cables as well as all power cables.
2. Local Door Alarm shall be flush mounted above the door as indicated on the plans.
Program the controller to identify the address, location and call type over the Security Network to the VA Police Station.

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.

W. 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.

3.2 TESTING AND TRAINING

All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

-----END-----

SECTION 28 13 16
ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

Provide and install a complete Access Control System and Database Management as specified in this section. This Specification shall serve as a standard for interfacing the new Access Door to be connected to the existing Access Control Panels into the Existing Database Management provided by Physical Security Upgrade Project. (VA Project# 06-106)

1.2 RELATED WORK

- A. For firestopping application and use, Section 07 84 00, FIRESTOPPING.
- B. For all signage and labeling applications and use, Section 10 14 00, SIGNAGE.
- C. For power connections and cables, Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- D. For grounding of equipment, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- E. For infrastructure, Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- F. For infrastructure, Section 26 05 36, CABLE TRAYS FOR ELECTRICAL SYSTEMS.
- G. For perimeter lighting, Section 26 56 00, EXTERIOR LIGHTING.
- H. For access control, Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEM (PACS).
- I. For screening of personnel and shipments, Section 28 13 53, SECURITY ACCESS DETECTION.
- J. For security cameras, Section 28 23 00, VIDEO SURVEILLANCE.
- K. For emergency and interior communications, Section 28 26 00, ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS).
- L. For Warranty of Construction, Section 00 72 00, GENERAL CONDITIONS.
- M. For General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

1.3 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the Access Control System and Database Management as shown. The Contractor shall also provide certification as required.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is

stand-alone or a part of a Information Technology (IT) computer network.

- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

1.4 SUBMITTALS

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 02 41 00, DEMOLITION.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.
- D. Pre-installation design and as-built packages shall include, but not be limited to:
 - 1. Index Sheet that shall:
 - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
 - b. Provide a list of all security abbreviations and symbols.
 - c. Reference all general notes that are utilized within the design package.
 - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
 - 1) Outline all general and job specific work required within the design package.
 - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
 - 2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
 - a. Include a title block as defined above.
 - b. Define the drawings scale in both standard and metric measurements.
 - c. Provide device identification and location.
 - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).

- e. Identify all pull box and conduit locations, sizes, and fill capacities.
 - f. Address all general and drawing specific notes for a particular drawing sheet.
3. A riser drawing for each applicable security subsystem shall:
- a. Indicate the sequence of operation.
 - b. Relationship of integrated components on one diagram.
 - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
 - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
4. A system drawing for each applicable security system shall:
- a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
 - b. Provide full detail of all system components wiring from point-to-point.
 - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
 - d. Show device locations that correspond to the floor plans.
 - e. All general and drawing specific notes shall be included with the system drawings.
5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
- a. Device ID.
 - b. Device Location (e.g. site, building, floor, room number, location, and description).
 - c. Mounting type (e.g. flush, wall, surface, etc.).
 - d. Power supply or circuit breaker and power panel number.
 - e. In addition, for the CCTV Systems, provide the camera ID, camera type (e.g. fixed or pan/tilt/zoom (P/T/Z), lens type (e.g. for fixed cameras only) and housing model number.
6. Detail and elevation drawings for all devices that define how they were installed and mounted.

- E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
1. 35 percent
 2. 65 percent
 3. 90 percent
 4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):
- 310D.....Racks, Panels, and Associated Equipment
- C. National Electrical Manufacturers Association (NEMA):
- 250-03.....Enclosures for Electrical Equipment
- D. National Fire Protection Association (NFPA):
- 70-05.....Article 780-National Electrical Code
- E. Underwriters Laboratories, Inc. (UL):
- 752-05.....Ballistic Level Protection (Class III)
- 827-96.....Central Station Alarm Services
- 1981-03.....Central Station Automation System
- F. Uniform Federal Accessibility Standards (UFAS) 1984
- G. Americans with Disabilities Act (ADA) 1975
- ADA Standards for Accessible Design 1994

1.6 WARRANTY OF CONSTRUCTION.

Warrant Access Control System work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. All equipment associated within the Access Control System and Database Management shall be UL 827 and UL 1981 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 96 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 easy 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 Access Control System and Database Management shall be set up as a Security System Network (SSN).
- B. A SSN shall provide full interface with all components of the security subsystem as follows:
 - 1. Shall allow for communication between the 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 Access Control System and Database Management, and shall automatically annunciate any communication failures or system alarms to the Access Control System and Database Management operator providing identification of the system, nature of the alarm, and location of the alarm.
 - 3. Controlling devices shall be utilized to interface the Access Control System and Database Management with all field devices.

5. The Access Control System and Database Management shall house the following equipment i.e. refer to individual master specifications for each security subsystem's specific requirements: (Existing per Physical Security Upgrade Project PJ# 06-106)
 - 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.
- C. Security Console Bays. (Existing per Physical Security Upgrade Project PJ# 06-106) 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 plexiglass, 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

D. Access Control System and Database Management and Security Console Configuration(Existing per Physical Security Upgrade Project PJ# 06-106):

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 2.8mm 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 Access Control System and Database Management. 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 Access Control System and Database Management 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 Access Control System and Database Management.
 17. All controlling equipment and power supplies that must be wall mounted shall be mounted in a manner that maximizes usability of the Access Control System and Database Management 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.
- E. Access Control System and Database Management 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 Access Control System and Database Management 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.

F. Control Room Lighting:

1. The following factors shall taken into consideration for lighting of the Access Control System and Database Management 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

G. Remote/Secondary Access Control System and Database Management's: 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 Access Control System and Database Management and secondary Access Control System and Database Management.
3. Secondary stations shall not have priority over a primary Access Control System and Database Management.
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.

H. 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 Access Control System and Database Management or at a remote monitoring station, it shall not be less that 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.
10. All cables and conductors, except fiber optic cables, that act as a control, communication, or signal lines shall include surge protection. Surge protection shall be furnished at the equipment end and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within three (3) ft. (one (1) m.) of the building cable entrance. The inputs and outputs shall be tested in both normal and common mode using the following wave forms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 watts and 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 peak current of 500 amperes.
11. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. Fuses and relays shall not be used as a means of surge protection.

2.3 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

3.1 INSTALLATION

- A. System installation shall be in accordance with manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. All equipment shall be installed per the design package and the manufacturer's installation specifications.
- C. The Access Control System and Database Management 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.

- D. For integration purposes, the Access Control System and Database Management shall operate and control the following associated security subsystems:
1. The Access Control System and Database Management shall be the central point of monitoring, controlling, programming, and recording all security subsystems utilizing the Electronic Security Management System (SMS).
 2. The SMS shall utilize a central computer station that is capable of being connected to the VA's Local Area Network (LAN) or Internet.
- E. Integration with security subsystems shall be achieved by computer programming and the direct hardwiring of the systems. Determination of methodology should be addressed and outlined in advance with the Contracting Officer prior to the system(s) is/are being designed and engineered.
- F. For programming purposes, the Contractor shall refer to the manufacturer's 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.
- G. 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 security subsystems. The Contractor shall not take any corrective action without written permission from the Contracting Officer.
- H. System Startup:
1. The Contractor shall not apply power to the Access Control System and Database Management or security console until the following items have been completed:
 - a. Access Control System and Database Management equipment items and have been set up in accordance with manufacturer's instructions.
 - b. A visual inspection of the Access Control System and Database Management 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 to be connected to all systems has 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 installations, defective equipment items, or collateral damage as a result of Contractor work/equipment installation efforts.
- I. Supplemental Contractor Quality Control:
 - 1. The following requirements supplement the contractor quality control requirements specified elsewhere in the contract:
 - a. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed Access Control System and Database Management and security console; and are approved by the Contracting Officer in advance.
 - b. The Contractor representatives will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
 - c. The Contractor representatives shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
 - d. The Contractor technical representatives shall participate in the testing and validation of the system and shall provide certification that their respective system portions meet its contractual requirements.

3.2 TESTING AND TRAINING

All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

-----END-----

SECTION 28 23 00
VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 DESCRIPTION

Provide and install an Extension to the Existing Video Surveillance System, which is identified as the Closed Circuit Television System hereinafter referred to as the CCTV System as specified in this section.

1.2 RELATED WORK

- A. For firestopping application and use, Section 07 84 00, FIRESTOPPING.
- B. For labeling and signs, Section 10 14 00, SIGNAGE.
- C. For connection of high voltage, Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- D. For power cables, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- E. For grounding of equipment, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- F. For infrastructure, Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- G. For infrastructure, Section 26 05 36, CABLE TRAYS FOR ELECTRICAL SYSTEMS.
- H. For perimeter lighting, Section 26 56 00, EXTERIOR LIGHTING.
- I. For access control, Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEMS (PACS).
- J. For screening of personnel and shipments, Section 28 13 53, SECURITY ACCESS DETECTION.
- K. For alarm systems, Section 28 16 11, INTRUSION DETECTION SYSTEM (IDS).
- L. For control and operation of all security systems, Section 28 13 16, ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT.
- M. For emergency and interior communications, Section 28 26 00, ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS).
- N. For Warranty of Construction, Section 00 72 00, GENERAL CONDITIONS.
- O. For General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

1.3 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the CCTV System as shown. The Contractor shall also provide certification as required.

- B. The CCTV System shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

1.4 SUBMITTALS

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, Shop Drawings, Product Data, and Samples, and Section 02 41 00, Demolition Drawings.
- B. Provide certificates of compliance with Section 1.3, 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. Pre-installation design and as-built packages shall include, but not be limited to:
 - 1. Index Sheet that shall:
 - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
 - b. Provide a list of all security abbreviations and symbols.
 - c. Reference all general notes that are utilized within the design package.
 - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
 - 1) Outline all general and job specific work required within the design package.
 - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
 - 2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
 - a. Include a title block as defined above.
 - b. Define the drawings scale in standard measurements.
 - c. Provide device identification and location.

- d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
 - e. Identify all pull box and conduit locations, sizes, and fill capacities.
 - f. Address all general and drawing specific notes for a particular drawing sheet.
3. A riser drawing for each applicable security subsystem shall:
- a. Indicate the sequence of operation.
 - b. Relationship of integrated components on one diagram.
 - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
 - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
4. A system drawing for each applicable security system shall:
- a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
 - b. Provide full detail of all system components wiring from point-to-point.
 - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
 - d. Show device locations that correspond to the floor plans.
 - e. All general and drawing specific notes shall be included with the system drawings.
5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
- a. Device ID.
 - b. Device Location (e.g. site, building, floor, room number, location, and description).
 - c. Mounting type (e.g. flush, wall, surface, etc.).
 - d. Power supply or circuit breaker and power panel number.
 - e. In addition, for the CCTV Systems, provide the camera ID, camera type (e.g. fixed or pan/tilt/zoom (P/T/Z), lens type (e.g. for fixed cameras only) and housing model number.

6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule.
- 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)/Electronic Industries Alliance (EIA):
 - 330.....Electrical Performance Standards for CCTV Cameras
 - 375A.....Electrical Performance Standards for CCTV Monitors
- C. Institute of Electrical and Electronics Engineers (IEEE):
 - C62.41.....IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
 - 802.3af.....Power over Ethernet Standard
- D. National Electrical Contractors Association (NECA):
 - 303-2005.....Installing Closed Circuit Television (CCTV) Systems
- E. National Fire Protection Association (NFPA):
 - 70-05.....Article 780-National Electrical Code
- F. Federal Information Processing Standard (FIPS):
 - 140-2.....Security Requirements for Cryptographic Modules
- G. Underwriters Laboratories, Inc. (UL):

983-06.....Standard for Surveillance Camera Units
3044-01.....Standard for Surveillance Closed Circuit
Television Equipment

1.6 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. Provide final As Built drawings to COTR in AutoCAD 2007 Format.
- B. The floor plans shall include the following:
 - 1. All device locations with labels.
 - 2. Conduit locations.
 - 3. Head-end equipment and specific location.
 - 4. Wiring diagram.
 - 5. Labeling and administration documentation.
 - 6. Warranty certificate.
 - 7. System test results.

1.7 WARRANTY OF CONSTRUCTION.

Warrant CCTV System work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. All equipment associated within the CCTV System shall be UL 3004 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 added equipment shall operate on a 24volts alternating current (VAC); unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of 96 hours of run time in the event of a loss of primary power to the facility.
- C. The system 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.
- D. All CCTV System 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 NFPA 70, Chapter E. All equipment and materials for the system will be compatible to ensure correct operation.

2.2 EQUIPMENT ITEMS

- A. CCTV system shall meet following requirements:
- B. All Cameras will be EIA 330 and UL 983 compliant as well as:
 - 1. Will be charge coupled device (CCD) cameras and shall conform to National Television System Committee (NTSC) formatting.
 - 2. Pan/Tilt/Zoom (P/T/Z) cameras shall be color and the primary choice for monitoring following the activities described below.
 - 3. Shall be powered by 24 VAC. Power supplies shall be Class 2 and UL compliant and have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the CCTV System.
 - 4. Shall be rated for continuous operation under the following environmental conditions:
 - a. Ambient temperatures of minus 10 degrees C (14 degrees F) to 55 degrees C (131 degrees F) utilizing equipment that will provide automatic heating and cooling.
 - b. Humidity, wind gusts, ice loading, and seismic conditions specified or encountered for locations where CCTV cameras will be utilized.
 - 5. Will be home run to a monitoring and recording device via a controlling device such as the existing DX8100 Series Digital Video Recorders or new a matrix switcher and network server and monitored on a 24 hour basis at a existing Access Control System and Database Management location, VA Police Station.
 - 6. Each function and activity shall be addressed within the system by a unique twenty (20) character user defined name. The use of codes or mnemonics identifying the CCTV action shall not be accepted.
 - 7. Shall interface with existing built-in video motion detection that shall automatically monitor and process information from each camera. The camera motion detection shall detect motion within the camera's field of view and provide automatic visual, remote alarms, and motion-artifacts as a result of detected motion as follows:

- a. Motion-detection settings shall include adjustable object size and velocity, as well as a selectable detection area of 132 zones in a twelve (12) x eleven (11) grid.
 - b. Sensors shall accept video signals from CCTV cameras and when synchronizing is required, it shall be in composite synchronization.
 - c. Sensor processors shall detect motion by digitizing multiple pixels within each video scene and by comparing the gray scale of the pixels to a previously stored reference. The number of pixels digitized depends on the application. The designer of the system shall consider cost effectiveness as a factor since digitizing a large number of pixels could increase cost dramatically with little additional actual detection capability for a specific application.
 - d. An alarm shall be initiated when the comparison varies by six (6) percent or more.
8. Appropriate signage shall be designed, provided, and posted that notifies people that an area is under camera surveillance.
 9. Dummy or fake cameras will not be utilized at any time.
 10. Shall be programmed to digitally flip from color to black and white at dusk and vise versa at dawn.
 11. Will be fitted with auto-iris lenses to ensure the image is maintained in low light.
 12. Lightning protection shall be IEEE C62.41 compliant and provided for all cameras. Either surge protectors or a lightning grid may be utilized. Ensure all lightning protection equipment is compliant with Article 780 of the National Electrical Code (NEC). The use of Fuses and Circuit Breakers as a means of lightning protection shall not be allowed.
 13. If using the camera as part of a CCTV network a video encoder shall be used to convert the signal from National Television System(s) Committee (NTSC) to Moving Picture Experts Group (MPEG) format.
 14. P/T/Z cameras shall be utilized in a manner that they compliment fixed cameras and shall be used as a primary means of monitoring activity.
 15. P/T/Z Cameras Technical Characteristics:

Effective Pixels	768 (H) x 494 (V)
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Scanning Area	1/4-type EXview HAD
Synchronization	Internal/Line-lock/Multiplexed Vertical Drive (VD2)
Video Output	1.0 V[p-p] NTSC composite/75 ohm
H. Resolution	570-line at B/W, or 540-line at color imaging
Signal-to-noise Ratio	50dB (AGC off, weight on)
Super Dynamic II	128 times(selectable on/off)
Minimum Illumination	0.06 lx (0.006 fc) at B/W, 1 lx(0.1 fc)
Zoom Speed	3.2/4.6/6.6 Seconds
Focus Speed	Approx. 2s (FAR/NEAR) in sequence mode
Iris	Automatic (Open/Close is possible)/manual
Maximum Aperture Ratio	1:1.6 (Wide) ~ 3.0 (Tele)
Focal Length	3.79 ~ 83.4 mm
Angular Field of View	H 2.6° ~ 51.7° V 2.0° ~ 39.9°
Electronic Shutter	1/60 (off), 1/100, 1/250, 1/500, 1/1,000, 1/2,000, 1/4,000, 1/10,000 s
Zoom Ratio	Optical 35x w/12x electronic zoom
Iris Range	F1.6 ~ 64, Close
Panning Range	360° endless
Panning Speed	Manual: Approx. 0.1°/s ~ 150°/s manual operation
Tilting Range	0 ~ 90° (Digital Flip off), 0 ~180° (Digital Flip on)
Tilting Speed	Manual: Approx. 0.1°/s ~ 40°/s manual operation
Pan/Tilt	Manual/Sequential position/Auto Pan
Controls	Pan/Tilt, Lens, 256 Preset Positions, Home Position
Video Connector	BNC
Controller I/F	Multiplex-coaxial

C. Lenses: Shall be utilized in a manner that provides maximum coverage of the area being monitored by the camera. The lenses shall:

1. Be 1/3" to fit CCD fixed camera.
2. Be all glass with coated optics.
3. Have mounts that are compatible with the camera selected.
4. Be packaged and supplied with the camera.
5. Have a maximum f-stop of f/1.3 for fixed lenses, and a maximum f-stop of f/1.4 for variable focus lenses.
6. Be equipped with an auto-iris mechanism.
7. Have sufficient circle of illumination to cover the image sensor evenly.
8. Not be used on a camera with an image format larger than the lens is designed to cover.
9. Be provided with pre-set capability.

D. Two types of lenses shall be utilized for both interior and exterior fixed cameras:

1. Manual Variable Focus
2. Auto Iris Fixed

E. Manual Variable Focus:

1. Shall be utilized in large areas that are being monitored by the camera. Examples of this are perimeter fence lines, vehicle entry points, parking areas, etc.
2. Shall allow for setting virtually any angle of field, which maximizes surveillance effects.

3. Technical Characteristics:

Image format	1/3 inch
Focal length	5-50mm
Iris range	F1.4 to close
Focus range	1m (3.3 ft)
Back focus distance	10.05 mm (0.4 in)
Angle view Wide (1/3 in)	53.4 x 40.1
Angle view Tele (1/3 in)	5.3 x 4.1
Iris control	manual
Focus ctrl	manual
Zoom ctrl	manual

F. Auto Iris Fixed

1. Shall be utilized in areas where a small specific point of reference is to be monitored. Examples of this are doorways, elevators, cashier booths, etc.
2. To determine the exact size of the fixed lens required, complete a focal length calculation using either a focal length calculator or a focal length chart provided by the product manufacturer.
3. Technical Characteristics:

Image format	1/3 inch	1/3 inch	1/3 inch
Focal length	2.8 mm	4 mm	8 mm
Iris range	F1.2 - 200	F1.2 - 200	F1.2 - 200
Min. Object	0.3 m (1 ft)	0.3 m (1 ft)	0.3 m (1 ft)
Lens mount	CS-mount	CS-mount	CS-mount
Angle of view	94 X 72	64 X 49	33 x 25
Focus control	Manual	Manual	manual

G. Camera Housings and Mounts:

1. This section pertains to all interior and exterior housings, domes, and applicable wall, ceiling, corner, pole, and rooftop mounts associated with the housing. Housings and mounts shall be specified in accordance to the type of cameras used.
2. All cameras and lenses shall be enclosed in a tamper resistant housing. Any additional mounting hardware required to install the camera housing at its specified location shall be provided along with the housing.
3. The camera and lens contained inside the housing shall be installed on a camera mount. All additional mounting hardware required to install the camera housing at its specified location shall be provided along with the housing.
4. Shall be manufactured in a manner that are capable of supporting a maximum of three (3) cameras with housings, and meet environmental requirements for the geographical area the camera support equipment is being installed on or within.
5. Environmentally Sealed
 - a. Shall:
 - 1) Be designed in manner that it provides a condensation free environment for correct camera operation.

- 2) Operate in a 100 percent condensing humidity atmosphere.
- 3) Be constructed in a manner that:
 - a) Has a fill valve to allow for the introduction of nitrogen into the housing to eliminate existing atmospheric air and pressurize the housing to create moisture free conditions.
 - b) Has an overpressure valve to prevent damage to the housing in the event of over pressurization.
 - c) Is equipped with a humidity indicator that is visible to the eye to ensure correct atmospheric conditions at all times.
 - d) The leak rate of the housing is not to be greater than 13.8kPa or 2 pounds per square inch at sea level within a 90 day period.
 - e) It shall contain camera mounts or supports as needed to allow for correct positioning of the camera and lens.
 - f) The housing and sunshield are to be white in color.
- b. All electrical and signal cables required for correct operations shall be supplied in a hardened carrier system from the controller to the camera.
- c. The mounting bracket shall be adjustable to allow for the housing weight of the camera and the housing unit it is placed in.
- d. Accessibility to the camera and mounts shall be taken into consideration for maintenance and service purposes.
6. Interior Premier Integrated Dome System
 - a. The interior dome shall be a pendant mount, pole mount, ceiling mount, surface mount, or corner mounted equipment.
 - b. The lower portion of the dome that provides camera viewing shall be made of black opaque acrylic and shall have a light attenuation factor of no more than 1 f-stop.
 - c. The housing shall be equipped with integral pan/tilt capabilities complete with wiring, wiring harness, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to fully provide a fully functional pan/tilt dome.
 - d. The pan/tilt mechanism shall be:
 - 1) Constructed of heavy duty bearings and hardened steel gears.
 - 2) Permanently lubricated to ensure smooth and consistent movement of all parts throughout the life of the product.

- 3) Equipped with motors that are thermally or impedance protected against overload damage.
- e. Pan movements shall be 360 degrees and tilt movement shall no be less than +/- 90 degrees.
- f. Pan speed shall be a minimum of 10 degrees per second.

H. Existing Controlling Equipment:

This section shall provide a standard for interfacing of new Autodome cameras to the existing DVR System located in the VA Police Station.

- 1. Shall be utilized to call up, operate, and program all cameras associated CCTV System components.
- 2. Will have the ability to operate the cameras locally and remotely. An existing DVR Matrix or new matrix switcher is utilized as the CCTV System controller.
- 3. The controller is provided in standard 19" (47.5 cm) equipment racks located in the VA Police Station.
- 4. Control and programming keyboards are existing and provide the following:
 - a. Are located at the monitoring station.
 - b. Are addressable for programming purposes.
 - c. Provide interface between the operator and the CCTV System.
 - d. Provide full control and programming of the switcher.
 - e. Have the minimum following controls:
 - 1) programming
 - 2) switching
 - 3) lens function
 - 4) P/T/Z
 - 5) environmental housing
 - 6) annotation

6. Network Server

This section shall provide a standard for interfacing of new Autodome cameras to the existing DVR System located in the VA Police Station.

- a. Allow for the transmission of live video, data, and audio over either an existing Ethernet network or a dedicated security system network, requiring an IP address or Internet Explorer 5.5 or higher, or shall work as an analog-to-Ethernet "bridge"

controlling matrices, multiplexers, and pan/tilt/zoom cameras. The network shall operate in a box-to-box configuration allowing for encoded video to be decoded and displayed on an analog monitor.

- b. If a CCTV System network is going to be utilized as the primary means of monitoring, operating, and recording cameras then the following equipment shall be required as part of the system:
 - 1) System Server
 - 2) Computer Workstation
 - 3) Recording Device
 - 4) Encoder/Decoder
 - 5) Monitor
 - 6) Hub/Switch
 - 7) Router
 - 8) Encryptor
- c. Provides overall control, programming, monitoring, and recording of all cameras and associated devices within the CCTV System.
- d. All equipment on the network is IP addressable.

I. Recording Devices

This section shall provide a standard for interfacing of new Autodome Cameras to the existing DVR System located in the VA Police Station.

- 1. All cameras on the CCTV System shall be recorded in real time using the existing Digital Video Recorder (DVR).
- 2. All recording devices are 19"(47.5 cm) rack-mountable.
- 3. All DVR's that are viewable over an Intranet or Internet will be routed through an encryptor. Encryptors shall:
- 4. Digital Video Recorder (DVR):
 - a. Record video to a hard drive-based digital storage medium in either NTSC or MPEG format.
 - b. Meets the following minimum requirements:
 - 1) Record at minimum rate of 30 images per second (IPS).
 - 2) Have a minimum of eight (8) to 16 looping inputs.
 - 3) Have a minimum of eight (8) to 16 alarm inputs and two (2) relay outputs.
 - 4) Shall provide instantaneous playback of all recorded images.
 - 5) Be IP addressable, if part of a CCTV network.
 - 6) Have built-in digital motion detection with masking and sensitivity adjustments.

- 7) Provide easy playback and forward/reverse search capabilities.
- 8) Complete audit trail database, with minimum of a six-month history that tracks all events related to the alarm; specifically who, what, where and when.
- 9) DVR management capability providing automatic video routing to a back-up spare recorder in case of failure.
- 10) Accessible locally and remotely via the Internet, Intranet, or a personal digital assistant (PDA).
- 11) Records all alarm events in real time, ensuring 60 seconds before and after the event are included in the recording.
- 12) Utilize RS-232 or fiber optic connections for integration with the SMS computer station via a remote port on a network hub.
- 13) Allow for independently adjustable frame rate settings.
- 14) Be compatible with the matrix switcher utilized to operate the cameras. The DVR could be utilized as a matrix switcher only if it meets all of the requirements listed in the matrix switcher section.

c. Technical Characteristics:

Processor	Intel Pentium III 750 MHz
Memory	256 MB RAM
Operating System	Windows 98, NT, ME, 2000, and XP
Video Card	4 MB of RAM capable of 24-bit true color display
Free Hard Disk Space	160 MB for software installation
Network Card	10Base-T network for LAN operation
Archiving	80 GB, 160 GB, 320 GB and 640 GB Hard Drive; CD-RW
Video Input	1.0 Vpp (signal 714mV, sync 286mV) 75 ohms (BNC unbalanced)
Video Output Level	1.0 Vpp +/-10%, 75 ohms (BNC unbalanced)
Impedance	75 ohms/Hi- impedance x 16 switchable
Network Interface	Ethernet (RJ-45, 10/100M)

Network Protocol	TCP/IP, DHCP, HTTP, UDP
Network Capabilities	Live/Playback/P/T/Z control
Recording Rate	30 ips for 720 x 240 (NTSC)
Password Protection	Menu Setup, Remote Access
Recording Capacity	160 (1 or 2 fixed HDD) 1 CD-RW
Power Interrupt	Auto recovered to recording mode

J. Camera Remote Power Supply

1. Shall meet or exceed the manufactures recommendation for class 2 power and be UL Listed for Commercial CCTV Equipment(UL 2044).
2. Shall be powered by 120VAC, 50/60 Hz. Connected to the Critical Emergency power source.
3. Shall provide 24VAC PTC protected power limited outputs for CCTV Camera Power.
4. Shall provide onboard surge suppression.
5. Shall provide a power disconnect breaker with manual reset.
6. The Power Supply shall provide adequate power for the planned number of cameras plus 50% spare.
7. The Power Supply shall be provided with an enclosure and provide battery backup for camera power. Backup time shall correspond to the requirements and duration of the existing Hospital CCTV System.
8. The power supply enclosure assembly shall be wall mounted in the IT Room. Install a CCTV terminal cabinet above for central termination of all CCTV camera cables.

K. CCTV Terminal Cabinet

1. The cabinet shall be constructed of heavy 16 gauge cold rolled steel, have top and side panels and hinged front door. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the using Facility Service Chief or the RE. The cabinet shall be surface or flush mounted. Flush mounted cabins shall be provided with means to match the fire rating of the wall to be installed in.

2. Technical Characteristics:

Overall height	18" maximum
Overall depth	6" maximum
Overall width	18" maximum

L. Wires and Cables

1. Shall meet or exceed the manufactures recommendation for power and signal.
2. Will be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS).
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 clearly marked with colored permanent tape or paint that will allow it to be distinguished from all other conduit and infrastructure.
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 system shall be defined as any cable or sets of cables carrying 30 VDC/VAC or higher.
9. For all equipment that is carrying digital data between the Access Control System and Database Management or at a remote monitoring station, shall not be less that 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.
10. All cables and conductors, except fiber optic cables, that act as a control, communication, or signal lines shall include surge protection. Surge protection shall be furnished at the equipment end and additional triple electrode gas surge protectors rated for the

application on each wire line circuit shall be installed within three (3) ft. (one (1) m.) of the building cable entrance. The inputs and outputs shall be tested in both normal and common mode using the following wave forms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 watts and peak current of 60 amperes.
 - b. An 8 microsecond rise time by 20 microsecond pulse width wave form with a peak voltage of 1000 volts and peak current of 500 amperes.
11. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. Fuses and relays shall not be used as a means of surge protection.
12. Coaxial Cables
- a. All video signal cables for the CCTV System shall be a coaxial cable and have a characteristic impedance of 75 ohms plus or minus 3 ohms.
 - b. For runs up to 750 feet use of an RG-59/U is required. The RG-59/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 23 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
 - c. For runs between 750 feet and 1250 feet, RG-6/U is required. RG-6/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 18 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
 - d. For runs of 1250 to 2750 feet, RG-11/U is required. RG-11/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 14 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
 - e. All runs greater than 2750 feet will be substituted with a fiber optic cable. If using fiber optics as a signal carrier then the following equipment will be utilized:
 - 1) Multimode fiber optic cable a minimum size of 62 microns
 - 2) Video transmitter, installed at the camera that utilizes 12 VDC or 24 VAC for power.

3) Video receiver, installed at the switcher.

f. RG-59/U Technical Characteristics

AWG	22
Stranding	7x29
Conductor Diameter	.031 in.
Conductor Material	BCC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.145 in.
Outer Shield Type	Braid/Braid
Outer Jacket Material	PVC
Overall Nominal Diameter	.242 in.
UL Temperature Rating	75°C
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.094 μ H/ft
Nom. Capacitance	Conductor to Shield 17.0 pF/ft
Nom. Velocity of Propagation	80 %
Nom. Delay	1.3 ns/ft
Nom. Conductor DC Resistance @ 20°C	12.2 Ohms/1000 ft
Nom. Outer Shield DC Resistance @ 20°C	2.4 Ohms/1000 ft
Max. Operating Voltage	UL 300 V RMS

g. RG-6/U Technical Characteristics:

AWG	18
Stranding	7x27
Conductor Diameter	.040 in.
Conductor Material	BC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.180 in.

Outer Shield Material	Trade Name Duofoil
Outer Shield Type	Tape/Braid
Outer Shield %Coverage	100 %
Outer Jacket Material	PVC
Overall Nominal Diameter	.274 in.
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.106 μ H/ft
Nom. Capacitance	Conductor to Shield 16.2 pF/ft
Nom. Velocity of Propagation	82 %
Nom. Delay	1.24 ns/ft
Nom. Conductor DC Resistance	6.4 Ohms/1000 ft
Nominal Outer Shield DC Resistance @ 20°C	2.8 Ohms/1000 ft
Max. Operating Voltage	UL 300 V RMS

h. RG-11/U Technical Characteristics:

AWG	15
Stranding	19x27
Conductor Diameter	.064 in.
Conductor Material	BC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.312 in.
Inner Shield Type	Braid
Inner Shield Material	BC - Bare Copper
Inner Shield %Coverage	95 %
Inner Jacket Material	PE - Polyethylene
Inner Jacket Diameter	.391 in.
Outer Shield Type	Braid
Outer Shield Material	BC - Bare Copper
Outer Shield %Coverage	95 %

Outer Jacket Material	Trade Name Belflex
Outer Jacket Material	PVC Blend
Overall Nominal Diameter	.520 in.
Operating Temperature Range	-35°C To +75°C
Non-UL Temperature Rating	75°C
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.097 μ H/ft
Nom. Capacitance	Conductor to Shield 17.3 pF/ft
Nom. Velocity of Propagation	78 %
Nom. Delay	1.30 ns/ft
Nom. Conductor DC Resistance	3.1 Ohms/1000 ft
Nom. Inner Shield DC Resistance	1.8 Ohms/1000 ft
Nom. Outer Shield DC Resistance	1.4 Ohms/1000 ft
Max. Operating Voltage Non-UL	300 V RMS

I. Fiber Optic Cables Technical Characteristics:

Fiber Type	62.5 Micron
Number of Fibers	4
Core Diameter 6	2.5 +/- 2.5 microns
Core Non-Circularity	5% Maximum
Clad Diameter	125 +/- 2 microns
Clad Non-Circularity	1% Maximum
Core-clad Offset	1.5 Microns Maximum
Primary Coating Material	Acrylate
Primary Coating Diameter	245 +/- 10 microns
Secondary Coating Material	Engineering Thermoplastic
Secondary Coating	900 +/- 50 microns

Diameter	
Strength Member Material	Aramid Yarn
Outer Jacket Material	PVC
Outer Jacket Color	Orange
Overall Diameter	.200 in.
Numerical Aperture	.275
Maximum Gigabit Ethernet	300 meters
Maximum Gigabit Ethernet	550 meters

13. Power Cables

- a. Will be sized accordingly and shall comply with the NEC. High voltage power cables will be a minimum of three conductors, 14 AWG, stranded, and coated with a non-conductive polyvinylchloride (PVC) jacket. Low voltage cables will be a minimum of 18 AWG, stranded and non-conductive polyvinylchloride (PVC) jacket.
- b. Will be utilized for all components of the CCTV System that require either a 110 VAC 60 Hz or 220 VAC 50 Hz input. Each feed will be connected to a dedicated circuit breaker at a power panel that is primarily for the security system.
- c. All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used as a means of surge protection.
- d. Shall be rated for either 110 or 220 VAC, 50 or 60 Hz, and shall comply with VA Master Spec 26 05 21 Low Voltage Electrical Power Conductors and Cables (600 Volts and Below).
- e. Low Voltage Power Cables
 - 1) Shall be a minimum of 18 AWG, Stranded and have a polyvinylchloride outer jacket.
 - 2) Cable size shall determined using a basic voltage over distance calculation and shall comply with the NEC's requirements for low voltage cables.

2.3 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 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 correctly provide the system documentation as required by this document and explained herein.

PART 3

3.1 INSTALLATION

- A. System installation shall be in accordance with NECA 303, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.
- D. The addition to the CCTV System will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a complete network.
- E. For integration purposes, the CCTV System shall be integrated where appropriate with the following associated security subsystems:
 1. PACS:
 - a. Provide 24 hour coverage of all entry points to the Project Area. As well as all emergency exits utilizing a fixed color camera.
 - b. Record cameras on a 24 hours basis.

- c. Be programmed go into an alarm state when an emergency exit is opened, and notify the Access Control System and Database Management of an alarm event.
 - d. For additional CCTV System requirements as they relate to the PACS, refer to Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEMS.
- 3. Security Access Detection:
 - a. Provide full coverage of the Emergency Department areas utilizing an Autodome P/T/Z color camera.
 - b. Record cameras on a 24 hours basis.
 - c. For additional CCTV System requirements as they relate to the Security Access Detection, refer to Master Specification 28 13 53.
- 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 addition to the CCTV System for the ED Remodel shall be comprised of, but not limited to, the following components:
 - 1. Cameras
 - 2. Lenses
 - 3. Camera Housings and Mounts
 - 4. Remote Camera Power Supply
 - 5. CCTV Terminal Cabinet
 - 6. Conduit
 - 7. Wiring and Cables
- I. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.
- J. Existing Equipment
 - 1. The Contractor shall connect to and utilize existing CCTV Control equipment, video and control signal transmission lines, and devices as outlined in the design package. Video equipment and signal lines

- that are usable in their original configuration without modification may be reused with Contracting Officer approval.
2. The Contractor shall perform a field survey, including testing and inspection of all existing video equipment and signal lines intended to be incorporated into the CCTV System, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
 3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.
 4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or incorrect installation of equipment.
 5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.
- K. Enclosure Penetrations: All enclosure penetrations shall be from the top of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit through rated partitions shall comply with VA Master Specification 07 84 00, Firestopping.
- L. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

M. Interconnection of Console Video Equipment: The Contractor shall connect signal paths between video equipment as specified by the OEM. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack.

N. Cameras:

1. Install the cameras with the focal length lens as indicated for each zone.
2. Connect power and signal lines to the camera.
3. Set cameras with fixed iris lenses to the f-stop to give full video level.
4. Aim camera to give field of view as needed to cover the alarm zone.
5. Focus the lens to give a sharp picture (to include checking for day and night focus and image quality) over the entire field of view; and synchronize all cameras so the picture does not roll on the monitor when cameras are selected. Dome cameras shall have all preset positions defined and installed.

M. System Start-Up

1. The Contractor shall not apply power to the CCTV System until the following items have been completed:
 - a. CCTV System equipment items and have been set up in accordance with manufacturer's instructions.
 - b. A visual inspection of the CCTV System has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
 - c. System wiring has been tested and verified as correctly connected as indicated.
 - d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
 - e. Power supplies to be connected to the CCTV System 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.

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 CCTV System; 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.

3.2 TESTING AND TRAINING

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 (EPPS)
DURESS, PANIC, MAN DOWN ALARM SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

Provide and install complete Duress-Panic-Man Down Alarm System hereafter referred to as EPPS System. Transmitting, receiving, transponding, multiplex signaling and audio/visual components of the Escort System shall be manufactured by Bosch Security Systems, unless specified otherwise within this document.

1.2 RELATED WORK

- A. For firestopping application and use, Section 07 84 00, FIRESTOPPING.
- B. For labeling and signs, Section 10 14 00, SIGNAGE.
- C. For connection of high voltage, Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- D. For power cables, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- E. For grounding of equipment, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- F. For infrastructure, Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
- G. For infrastructure, Section 26 05 36, CABLE TRAYS FOR ELECTRICAL SYSTEMS.
- H. For Installation, Section 28 05 11, Requirements for Electronic Safety and Security Installations.
- I. For Installation, Section 28 05 13, Conductors and Cable for Electronic Safety and Security Installations.
- J. For Installation, Section 28 05 26, Grounding and Bonding for Electronic Safety and Security Installations.
- K. For control and operation of all security systems, Section 28 13 16, ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT.
- L. For Warranty of Construction, Section 00 72 00, GENERAL CONDITIONS.
- M. For General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

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 Duress-Panic-Man Down Alarm System shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

1.4 SUBMITTALS

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWING, PRODUCT DATA, AND SAMPLES, and Section 02 41 00, DEMOLITION.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 42 x 30 inches (Architectural E1) drawing submittals shall be per the established project schedule.
- D. Pre-installation design and as-built packages shall include, but not be limited to:
 - 1. Index Sheet that shall:
 - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
 - b. Provide a list of all security abbreviations and symbols.
 - c. Reference all general notes that are utilized within the design package.
 - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
 - 1) Outline all general and job specific work required within the design package.
 - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.

2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
 - a. Include a title block as defined above.
 - b. Define the drawings scale in standard 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 Duress-Panic-Man Down Alarm System and other security elements (e.g., annunciators, 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 the Duress-Panic-Man Down Alarm 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.
- 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 form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. Except for a specific date given the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of the System's submittal is technically approved by the VA, shall be enforced.
- B. National Fire Protection Association (NFPA):

70	National Electrical Code (NEC)
77	RECOMMENDED PRACTICE ON STATIC ELECTRICITY
99	Standard for Health Care Facilities
101	Life Safety Code

- C. Underwriters Laboratories, Inc. (UL):

65	Standard for Wired Cabinets
467	Standard for Grounding and Bonding Equipment

1069	Standard for Hospital Signaling and Nurse Call Equipment
1778	Standard for Uninterruptable Power Supply

D. Electronic Industries/Telecommunications Industries Associations
(EIA/TIA):

568	Commercial Building Telecommunications Wiring Standard
569	Commercial Building Telecommunications Pathways and Spaces Standard
606	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
607	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
RS-270	Tools, Crimping, Solderless Wiring Devices Recommended Procedures for User Certification

F. Joint Commission on Accreditation of Health Care Organization (JCAHCO):
Comprehensive Accreditation Manual for Hospitals

G. National and/or Government Life Safety Codes(s): The more stringent of each listed code.

1.6 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. Provide final As Built drawings to COTR in AutoCAD 2007 Format.
- B. The floor plans shall include the following:
1. All device locations with labels.
 2. Conduit locations.
 3. Head-end equipment and specific location.
 4. Wiring diagram.
 5. Labeling and administration documentation.
 6. Warranty certificate.
 7. System test results.

1.7 WARRANTY OF CONSTRUCTION.

Warrant EPPS System work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.

1.8 SYSTEM OVERVIEW

- A. The System shall be described as a Personal Safety System consisting of a network of transmitters, receivers, and redundant computers including proprietary software designed to provide users with a means of alerting security personnel when faced with an emergency situation.
 - a) The System shall consist of six basic components:
 - 1. Transmitters
 - 2. Multiplex Receivers
 - 3. Alert Units
 - 4. Transponders
 - 5. Central Console
 - 6. Proprietary Application Software
 - b) The System shall be activated by use of hand-held miniature radio transmitters, which shall be specifically designed for that purpose.
 - c) There shall be three types of System activation; Alarm, Test, and Supervision.
- B. An Alarm activation of the System shall cause:
 - a) a distinct warbling sound to be emitted from the activated Subscriber or Maintenance Transmitter to confirm that an alarm signal has been sent. For Silent Alarm purposes, there shall be no sound emitted from a Security Transmitter when activated, and typically an auto-tracking feature to begin sending signals periodically to the Central Console to allow location tracking events (refer to Transmitter models for details), and the Central Console to display:
 - 1. the name of the individual to whom the Transmitter is assigned, and
 - 2. a map showing the calculated location from which the transmission was made, and
 - 3. any other pertinent information such as related medical information of the individual to whom the Transmitter is assigned, and an alarm entry to be made in the Central Console's computer database.
- C. A Test activation of the System shall cause full System operation verification. Visual feedback of a successful Test shall include:

- a) a small green light to flash on a nearby interior Multiplex Receiver, and/or
 - b) the strobe to flash on a nearby exterior Alert Unit.
 - c) Specific transmitter types will automatically transmit supervision messages periodically. These messages allow the system to verify the transmitter is functioning normally, the battery level is adequate and to locate a transmitter that is not in an alarm state.
- D. Multiplex Receivers shall be located [on the grounds to be protected] [and] [within any buildings to be protected].
- E. To assure transmitted signal reception redundancy, Receivers shall be spaced close enough to assure activation of three or more Receivers on any alarm or test transmission within the protected area. For proper location, receivers must be spaced [300 feet outdoors] [91.5 meters outdoors] [or] [80 feet indoors] [24.5 meters indoors] from adjacent receivers.
- 1. Specific mounting locations will be determined using sound engineering judgment and through the use of the manufacturer's Installation Guides.
 - 2. Transponders shall be designed as device controllers for up to 64 devices, which shall be any combination of Multiplex Receivers and Alert Units.
 - 3. Devices shall be connected to Transponders by means of eight Multiplex Busses. Each bus uses four wires, two for power and two for data. Each bus shall be capable of supporting up to eight devices.
 - 4. Each Transponder shall communicate with the Central Console via [SE485 Data Bus] [or] [Spread Spectrum radio transmissions in the 902-928 MHz radio range].
 - 5. The System shall support up to 255 Transponders.
- F. The Central Console shall consist of one or more IBM [compatible] computers running the Security Escort(R) proprietary Application Software within a Microsoft Windows environment. One computer shall serve as the Main Controller for the entire System while the others shall serve as backup and remote workstations. The computers shall continually exchange information so that the backup computers are kept current.
- G. The Application Software shall have provisions to automatically send

pager messages containing the necessary Alarm information to roaming security personnel, and to send pager messages containing the necessary System trouble information to maintenance personnel.

- H. The Application Software shall support remote computer communications permitting off-site System and Factory maintenance technicians to monitor problems, run System diagnostics, and modify System operating parameters.
- I. The Contractor shall provide all power supplies, computers, peripheral devices and equipment required for a complete and operational System.

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 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 4 hours (hrs.) of run time in the event of a loss of primary power to the Duress-Panic-Man Down Alarm System 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.
 8. Wireless systems shall use radio frequency waves to link distributed transmitters and receivers. Specific characteristics of particular facility will determine best application. Contractor is responsible for determining best system using prediction program to determine where readable signals can be obtained and identify "dead spots".
 9. All hardwired alarms, receivers, 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: Connect New receivers to the existing control equipment provided during the Phase 1 remodel. Provide expansion if necessary.
- 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.

2.3. Transmitters

Depending on the applications, there shall be three types of Transmitters available; Basic Duress Transmitter, Enhanced Duress Transmitter, and Point-Tracking Transmitter.

A. All Transmitters shall:

1. Upon activation, generate an Alarm transmission.
2. Each Alarm transmission shall consist of eight redundant packets, each packet to be 15 to 20 milli-seconds in length.
3. Each Alarm transmission shall consist of a unique digital code, which contains a User ID and battery status information.
4. Be capable of a minimum of 16 million different User Identification (ID) codes, one of which shall be programmed into the transmitter's digital code by the manufacturer. The digital code shall differentiate the specific transmitter as assigned to a User, Security or Maintenance personnel, or asset.

B. Basic Duress Transmitter.

1. Each Basic Duress Transmitter shall be a miniature, battery operated, hand-held radio transmitter designed for the purpose of transmitting both a Distress Alarm and a Test Signal. Radio transmissions shall occur in the 304Mhz band reserved for security applications.
2. Basic Duress Transmitters shall be packaged in a conveniently sized key-retainer type enclosure to encourage users to carry it on their person at all times. The enclosure shall be produced from U.L. Component Recognized material "Cycolac ABS" and shall measure approximately [2.7 inches long, by 1.5 inches wide, by 0.7 inches deep.] [6.8 cm long, by 3.8 cm wide, by 1.8 cm deep.] With transmitter circuitry and battery included, the package shall weigh approximately [1 ounce] [28 grams].
3. Basic Duress Transmitters shall be available in three types as follows:
 - a. User - designated with a "U" in the model number.
 - b. Security personnel - designated with an "S" in the model number.

- c. System Maintenance personnel - designated with an "M" in the model number.
- 4. The Basic Duress Transmitter enclosure shall contain two activation buttons, one on either side of the enclosure.
 - a. The buttons shall be recessed to prevent accidental usage.
 - b. A digitally coded Alarm transmission shall be generated when the two buttons are pushed simultaneously. The Basic Duress Transmitter shall automatically repeat the Alarm transmissions every 8 seconds for 15 minutes after it is activated by the User.
 - c. A digitally coded Test transmission shall be generated when the two buttons are pressed in sequence.
 - d. The Basic Duress Transmitter shall be designed such that the user may press either button, release, then press the remaining button to activate a test transmission.
- 5. The Basic Duress Transmitter shall produce a nominal 100 microwatt of power when activated, and shall require no special agency ([FCC] or [ACA]) radio license to operate.
- 6. The Basic Duress Transmitter shall be powered from a customer-replaceable Lithium battery.
 - a. The design of the Basic Duress Transmitter shall assure a nominal battery life of four years including four test transmissions by the User each day.
- 7. The Transmitter shall be designed to operate within the temperature range of [-22 degrees F to +145 degrees F.] [-30 degrees C to +65 degrees C.]
- 8. MAKE: Bosch Security Systems [SE3U-304 User Transmitter] [SE3M-304 Maintenance Transmitter] [SE3S-304 Security Transmitter].
- C. Enhanced Duress Transmitter.
 - 1. Each Enhanced Duress Transmitter shall be a miniature, battery operated, hand-held radio transmitter designed for the purpose of transmitting both a Distress Alarm and a Test Signal. Radio transmissions shall occur in the 304Mhz band reserved for security applications.
 - 2. Enhanced Duress Transmitters shall be packaged in a conveniently sized enclosure allowing users to carry it on a utility belt at all times. The enclosure shall be produced from U.L. Component Recognized material "Cycolac ABS" and shall measure approximately [4

- inches long, by 1.6 inches wide, by 0.8 inches deep.] [8.03 cm long, by 4.55 cm wide, by 1.70 cm deep.] With transmitter circuitry and battery included, the package shall weigh approximately [2.4 ounces] [68 grams].
3. Enhanced Duress Transmitters shall be available in three types as follows:
 - a. User - designated with a "U" in the model number.
 - b. Security personnel - designated with an "S" in the model number.
 - c. System Maintenance personnel - designated with an "M" in the model number.
 4. The Enhanced Duress Transmitter enclosure shall contain two activation buttons (alarm and test), one pull-switch (optional), supervision circuit, and tilt circuit.
 - a. The buttons shall be recessed to prevent accidental usage.
 - b. A digitally coded Alarm transmission shall be generated when the alarm button is pushed. The Enhanced Duress Transmitter shall automatically repeat the Alarm transmissions every 8 seconds for 15 minutes after it is activated by the User.
 - c. A digitally coded Test transmission shall be generated when the test button and alarm button are simultaneously pressed.
 1. This transmission shall consist of four redundant packets.
 - d. A digitally coded Alarm transmission shall be generated when the pull-switch is activated (optional/feature selectable).
 - e. The Enhanced Duress Transmitter shall automatically repeat the Alarm transmissions every 8 seconds until corrected and then auto-Tracks 15 minutes.
 - f. A Man-Down Alarm transmission shall be generated when Transmitter is tipped 60° from upright (feature selectable).
 1. This shall consist of eight redundant packets.
 2. The Enhanced Duress Transmitter shall automatically repeat the Alarm transmissions every 8 seconds until corrected and then auto-tracks for 15 minutes after last activated by the User.
 - g. A supervision transmission shall be generated automatically (feature selectable).
 1. This transmission shall be silent.
 2. Each transmission shall occur at a lower RF power than an Alarm transmission and shall consist of a unique digital code with contains a User ID and battery status information.

5. The Enhanced Duress Transmitter shall produce a nominal 100 Microwatt of power when activated, and shall require no special agency ([FCC] or ACA) radio license to operate.
 6. The Enhanced Duress Transmitter shall be powered from a customer replaceable Lithium battery.
 - a. The design of the Enhanced Duress Transmitter shall assure a Nominal battery life of four years including four test transmissions by the user each day.
 7. The Enhanced Duress Transmitter shall be designed to operate within the temperature range of [-22 degrees F to +145 degrees F.] [-30 degrees C to +65 degrees C.]
 8. MAKE: Bosch Security Systems [SE2U-304 User] [SE2M-304 Maintenance Transmitter] [SE2S-304 Security Transmitter] [SE2U-SN-304 Subscriber Man-Down Transmitter] [SE2SSN-304 Security Man-Down Transmitter].
- D. Point-Tracking Transmitter.
1. Each Point Tracking Transmitter shall be a miniature, battery operated radio transmitter designed for the purpose of transmitting an Alarm Signal when moved away from its base. Radio transmissions shall occur in the 304Mhz band reserved for security applications.
 2. Point Tracking Transmitters shall be packaged in a conveniently sized enclosure that allows it to be attached to objects of almost any size. The enclosure shall be produced from U.L. Component Recognized material "Cycolac ABS" and shall measure approximately [3.25 inches long, by 1.4 inches wide, by 0.87 inches deep.] [8.25 cm long, by 3.5 cm wide, by 2.2 cm deep.] with mounting plate.
 3. The Point Tracking Transmitter shall provide two methods of activation (magnetic and/or supervised dry contacts).
 - a. A digitally coded Alarm transmission shall be generated when the transmitter is moved away from its magnetic base, or if the dry contacts are separated.
 - b. A digitally coded tamper transmission shall be generated when the transmitter's cover is opened (tamper switch). The Point Tracking Transmitter shall automatically repeat the Alarm transmissions every 8 seconds for 15 minutes after it is activated.
 - c. A digitally coded Supervision transmission shall be generated every 65 minutes to provide location

information and battery status.

4. The Point Tracking Transmitter shall produce a nominal 100 micro-watt of peak power when activated, and shall require no special agency ([FCC] or [ACA]) radio license to operate.
5. The Point Tracking Transmitter shall be powered from a customer replaceable Lithium battery.
 - a. The design of the Point Tracking Transmitter shall assure a nominal battery life of four years including four sets of alarm and auto-tracking transmissions per day.
6. The Point Tracking Transmitter shall be designed to operate within the temperature range of [-22 degrees F to +145 degrees F.] [-30 degrees C to +65 degrees C.]
7. MAKE: Bosch Security Systems SE3401 Transmitter.

2.4 Multiplex Receivers

- A. Multiplex Receivers shall be designed to detect and receive Alarm, Test, and supervisory transmissions from Personal Transmitters, and relay the information to the Transponders.
- B. There shall be two versions of the Multiplex Receiver, indoors and outdoors. The Receivers shall differ only in the product housing, ability to display colored status lights, sounder operation and radio reception range.
 1. The indoor enclosure shall be vandal resistant. The enclosure shall consist of a base plus screw mounted cover manufactured from General Electric Noryl, Grade FN-215, with dimensions of [9.0 inches high, by 7.0 inches wide, by 1.8 inches deep.] [22.9 cm high, by 17.8 cm wide, by 4.6 cm deep.] The cover shall mount to the base with four tamper-resistant screws held captive in the cover, and the cover shall contain two clear lenses for the exhibition of status lights, and a circular opening to permit an internal sounder to be heard.
- C. Electronic circuitry for the Multiplex Receiver shall be constructed on a single piece, U. L. Component Recognized circuit board. Components on the circuit board shall include a red colored alarm status light, a green colored test-successful status light, a piezo-electric sounder capable of a minimum 85 dB output, and provisions to disable these components when installed in an outdoor enclosure. Status lights shall be Light Emitting Diodes (LEDs).

- D. Each Multiplex Receiver circuit board shall also contain a tamper switch to detect the removal of the cover.
- E. Each Multiplex Receiver shall be connected to a Transponder via an 18 AWG, fire rated 4 conductor cable.
 - 1. Solid, rather than stranded, conductor cabling shall be used.
 - 2. Outdoor cabling shall be [in conduit] [or] [direct burial], and shall not be strung overhead.
 - 3. There shall be a maximum of [3,000 feet] [900 meters] of cabling between each receiver and transponder.
 - 4. The cable shall act as a Multiplex Bus with two conductors dedicated to power, and two conductors dedicated to data exchange.
 - 5. Multiplex Receivers shall operate on 12 VDC, and draw a nominal 30 mADC in standby mode, and 60 mADC when the sounder and one status light are activated. Receivers shall draw all necessary power from the Transponder to which they are connected.
- F. Each Multiplex Receiver shall identify itself to its Transponder through use of a binary Multiplex Address, which shall be set during installation using a multi-position switch installed on the Receiver's circuit board.
- G. Each Multiplex Receiver shall contain radio receiver circuitry and two diversity antennas with auto-switching to detect the transmissions from Personal Transmitters, and microcomputers to decode and interpret the Test and Alarm signals. In addition, the microcomputers shall perform self-diagnostics and use an algorithm to perform error checking, and shall monitor the cover tamper switches. All events shall be reported to the Transponder over the data exchange bus.
- H. Each Multiplex Receiver shall contain a test transmitter similar to a Personal Transmitter for maintenance purposes. The Central Console shall automatically activate the test transmitter several times a day to transmit a "Buddy Check" Test to nearby Multiplex Receivers to verify that the radio receiver sections of all Multiplex Receivers are functioning properly.
- I. If enabled within the Application Software, any Multiplex Receiver installed in an indoor enclosure and receiving a radio transmission shall activate its sounder and turn on its red alarm status light within two seconds of a verified Subscriber Alarm transmission.

Lights and sounders shall remain in operation until commanded off/silent by the Central Console.

- J. Within two seconds of a verified Subscriber Test transmission, any Multiplex Receiver installed in an indoor enclosure and receiving the transmission shall flash its green indicator light for five seconds.
- K. Multiplex Receivers shall be designed to operate within the temperature range of [-40 degrees F to +149 degrees F.] [-40 degrees C to +65 degrees C.]

2.5 Transponders

- A. Transponders shall be designed to monitor and control Multiplex Receivers and Alert Units, and to communicate Alarm, Test and Trouble information back to the Central Console.
- B. There shall be two versions of Transponders, one that supports eight buses and one that supports one bus.
- C. Electronic circuitry for the Transponder shall be constructed on a single-piece, UL Component Recognized circuit board.
- D. There shall be a maximum of 255 Transponders in the System, and each Transponder shall be identified with a number from 1 to 255, which shall be set during installation using an 8-position switch installed on the circuit board.
- E. Transponders shall be connected to Alert Units and Multiplex Receivers via an 18 AWG, fire rated 4-conductor cable.
 - 1. Each Multiplex Bus shall be capable of supporting up to eight Alert Units and/or Multiplex Receivers in any combination.
 - 2. Transponders shall be capable of supporting up to eight Multiplex Busses for a total of 64 Alert Units and/or Multiplex Receivers or one Multiplex Bus for a total of eight Alert Units and/or Multiplex Receivers in any combination.
 - 3. Each bus shall be automatically numbered from 0 to 7 depending on the bus terminals on the circuit board to which they are connected.
- F. Transponders shall communicate on the data exchange wiring with individual Alert Units and Multiplex Receivers by issuing commands, which contain the Receiver or Unit's binary Multiplex Address. As a given Transponder may have up to eight devices connected to it with the same binary Multiplex Address, the complete identification of a particular device shall include the Transponder Identification

number, the bus number, and its binary Multiplex Address.

G. Transponders shall poll each connected Alert Unit and Multiplex Receiver for a status check ten times each second.

1. In the event one or more Multiplex Receivers receive an Alarm transmission, the Transponder shall collect the Transmitter Identification code and signal strength information from each affected Receiver and shall verify data validity by utilizing error-checking algorithms.

- a. Any Alarm data messages failing the error-checking algorithm tests shall be ignored.

1. If the data is valid and is a User Alarm, the Transponder shall select up to 15 Receivers based on signal strength, and command those Receivers to activate their sounders and red alarm status lights.

2. If the data is valid and is a Maintenance Alarm, the Transponder shall select up to 15 Receivers based on signal strength and turn on a red alarm light for a short time.

3. If the data is valid and is a Security Alarm, the Transponder shall select up to 15 Receivers based on signal strength.

- b. The Transponder shall then relay to the Central Console the Transmitter Identification code, the transmitter's battery condition, and the signal strength information and Address of each selected Receiver.

2. In the event one or more Multiplex Receivers receive a Test transmission, the Transponder shall collect signal strength information from each affected Receiver and shall verify data validity by utilizing error-checking algorithms.

- a. Any Test data messages failing the error-checking algorithm tests shall be ignored.

- b. If the data is valid, the Transponder shall select up to 15 Receivers based on signal strength.

- c. The Transponder shall then relay to the Central Console the Transmitter Identification code, the transmitter's battery condition, and the signal strength information and Address of each selected Receiver.

3. The Transponder shall also relay to the Central Console any

Trouble events such as a tamper Alarm, loss of AC power, receiver jamming or not responding, bus fault, or low battery.

- H. Transponders shall communicate with the Central Console via [SE485 Data Bus cabling] [or] [a 2-Way Spread Spectrum Radio Data Link]. [The SE485 Data Bus shall be set up for 9600 baud, full-duplex transmission.]
1. Transponders shall send a message to the Central Console at least every minute.
 2. If there is no Test, Alarm or Trouble message sent within a minute, the Transponder shall automatically send an "I'M OK" message, which shall be acknowledged by the Central Console's computer.
 3. If a Transponder determines that it has lost communications with the Central Console because its messages are not being acknowledged, it shall assume control of the sounders and lights of the Multiplex Receivers and Alert Units connected to it, and shall begin to send "I'M OK" messages every minute until acknowledged by the Central Console.
 4. If the Transponder receives an Alarm message from one or more of its Receivers during a loss of communications with the Central Console, it shall treat all such alarms as valid alarms. Further, the Transponder shall activate all Alert Units attached to it, and shall activate the sounders and red alarm status lights of all connected Receivers that detected the Alarm transmission, for four minutes.
 5. Transponders shall retain control of their Receivers and Alert Units until communications with the Central Console has been established, and the Transponder has received a "Release Control" command from the Central Console. On receipt of the command, the Transponder shall send any Alarm and Trouble messages to the Central Console that were stored during the loss of communications, and shall relinquish control of its Alert Units, and the sounders and red alarm status lights of its Receivers, to the Central Control.
- I. Power for the Transponder section shall be provided by an 18 VAC, 50 VA transformer. The transformer shall be a UL Listed, Class 2, plug-in device.

J. Transponders shall be designed to operate within the temperature range of [-40 degrees F to +149 degrees F.] [-40 degrees C to +65 degrees C.]

K. MAKE: Bosch Security Systems [EA500B (8-bus, 64 points), EA501B (1-bus, 8 points), and TR1850 transformer].

2.6 Enclosures

A. The electronic components shall be housed in two types of indoor enclosures, large and small.

1. The small indoor enclosure and cover shall be manufactured from painted 20 Ga., cold-rolled steel and shall measure [12.5 inches wide, by 14.5 inches high, by 3.375 inches deep] [32.0 cm wide, by 37.3 cm high, by 8.8 cm deep] when the cover is closed.

a. The cover shall secure to the enclosure using a keyed lock.

b. The enclosure shall allow an optional tamper switch to detect the opening of the cover or its removal from a wall.

c. The enclosure shall have provisions for housing one or two 12 volt, 7 amp-hour batteries as needed. If two batteries are used, they shall be wired in parallel to provide 14 amp-hours of standby battery capacity.

2. The large indoor enclosure shall be manufactured from painted 20 Ga., cold-rolled steel and shall measure [15 inches wide, by 4.25 inches deep, by 14.5 inches high] [38 cm wide, by 10.8 cm deep, by 36.8 cm high].

a. The cover shall secure to the enclosure using a keyed lock.

b. The enclosure shall allow an optional tamper switch to detect the opening of the cover or its removal from a wall.

c. The enclosure shall have provisions for housing one or two 12 volt, [7 amp-hour] [17 amp-hour] batteries as needed. If two batteries are used, they shall be wired in parallel to provide [14 amp-hours] [34 amp-hours] of standby battery capacity.

B. MAKE: Bosch Security Systems [AE1 (Small), AE3 (Large)]

2.7 Central Console

A. The Central Console shall be the primary human interface to the System.

B. The New Transponder shall report to the existing console at the VA police Station.

2.8 RS485 Data Bus Cabling

- A. Four conductor, unshielded, jacketed #22 A.W.G. solid-conductor cable shall be used as an RS485 Data Bus to connect up to 20 Transponders to the Central Console. The conductors shall be grouped into pairs with each pair twisted on its own axis.
- B. The maximum length of each bus shall not exceed [15,000 feet] [4,500 meters].
- C. The Transponders shall be daisy-chained to the bus, and the System design shall permit daisy chaining in any order.

2.9 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. Control Cable Shields
 - b. Data Cable Shields
 - c. Conduits
 - d. Cable Trays
 - e. Power Panels
 - f. Connector Panels
- C. 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.

- F. 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.
- G. 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.
- H. 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-Panic-Man Down Alarm System to be installed will be in accordance with physical security requirements unique to The VA facility.
- C. All wiring shall be installed in accordance with NFPA 70, the National Electrical Code.
- D. Provide a dedicated 120 volt, 20 ampere circuit in separate conduit as a source of primary power for the transponder.
- E. Perform walk tests and set up procedures for each receiver as specified by the manufacturer to insure that all boundaries of coverage are sufficient to detect alarm transmissions in each intended coverage area.
- F. Cleaning: Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.
- G. Provisions shall be made for systems in high-noise areas or areas with electrical interference environments.
- H. 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.

J. Installation Contractor shall provide complete wiring diagrams to the Electrical Contractor as part of the shop drawing submittal, and shall supervise the installation in order to insure a complete operating and trouble-free system.

K. Provide 3 sets of keys for all panels, stations and devices.

3.2 TESTS AND TRAINING

All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

-----END-----

SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, fire safety control devices, a NAC extender power supply and wiring as shown on the drawings and specified.
- B. Fire alarm systems shall comply with all requirements of NFPA 72. The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or higher or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the Contracting Officer or his authorized representative. Installers shall have a minimum of two years experience installing fire alarm systems.
- C. Fire alarm signals:
 - 1. Building 1 contains an existing automatic digitized voice fire alarm signal with emergency manual voice override to notify occupants to evacuate. The digitized voice existing message identifies the area of the building from which the alarm was initiated.
- D. Alarm signals provided by smoke detectors, manual pull stations, duct detectors, sprinkler flow switches, supervisory signals provided by Sprinkler tamper switches and system trouble signals caused cable or device faults shall be distinctly transmitted to the main fire alarm system control unit and Fire Works command center located in the VA police office.
- E. The existing main fire alarm control unit automatically transmits alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NFPA 72.

1.2 SCOPE

- A. All existing fire alarm equipment, devices and sub-systems that are in the project area shall be nondestructively removed and delivered to the electronics shop. All existing fire alarm wiring and conduit not reused or returned to the electronics shop shall be removed and disposed of per requirements of division 1.
- B. New fire alarm system devices shall be compatible and installed as an extension of the existing building fire alarm system. The installation of the new fire alarm system devices shall be designed and installed in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification.
- C. The Project area will be the Dental to Ambulatory Care Remodel, on the First Floor Southwest of Building 1.
- D. All Initiating Devices will be reconnected to the existing Signaling line circuit existing for the project area.
- E. Existing electromagnetic Door Holder circuits will be extended into the project area.
- F. New and existing Duct Smoke Detectors will monitor for air handler shut down.
- G. New Duct Smoke Detectors and area Smoke Detectors will monitor for damper closure.
- H. New and Existing Flow and Tamper Switches will monitor the sprinkler system.
- I. New Smoke Detectors will be installed in areas open to the corridor.
- J. Existing fire alarm door holders, 120VAC duct smoke detectors, valve tamper switches and waterflow/pressure switches may be reused only as specifically indicated on the drawings and provided the equipment:
 - 1. Meets this specification section
 - 2. Is UL listed or FM approved
 - 3. Is compatible with new equipment being installed
 - 4. Is verified as operable through contractor testing and inspection
 - 5. Is warranted as new by the contractor.
- K. Existing 120 VAC duct smoke detectors, waterflow/pressure switches, and valve tamper switches reused by the Contractor shall be equipped with an addressable interface device compatible with the new equipment being installed.
- L. Existing reused equipment shall be covered as new equipment under the Warranty specified herein.

M. Basic Performance:

1. Alarm and trouble signals from each building fire alarm control panel shall be annunciated at the Fire Works Command Station in the VA police office.
2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed five (5) seconds.
3. Initiating device circuits (IDC) shall be wired Class B in accordance with NFPA 72.
4. Signaling line circuits (SLC) within buildings shall be wired Style 4 Class B in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet of floor space or 3 floors whichever is less.
5. Notification appliance circuits (NAC) shall be wired Class B abnormal condition 2 in accordance with NFPA 72.

1.3 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES: Procedures for submittals.
- C. Section 07 84 00, FIRESTOPPING: Fire proofing wall penetrations.
- D. Section 08 71 00, DOOR HARDWARE: Combination Closer-Holders.
- E. Section 09 91 00, PAINTING: Painting for equipment and existing surfaces.
- F. Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS: Sprinkler systems
- G. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements for items which are common to other Division 26 sections.
- H. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and boxes for cables/wiring.
- I. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW: Cables/wiring.

1.4 SUBMITTALS

- A. General: Submit 4 copies and 1 reproducible in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Submittal Drawings:
 1. Prepare drawings using AutoCAD Release 2007 software and include all contractors' information. Layering shall be by VA criteria as provided by the Contracting Officer's Technical Representative (COTR). Bid drawing files on AutoCAD Release 2007 will be provided

to the Contractor at the pre-construction meeting. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.

2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.
3. Riser diagrams: Provide a complete fire alarm system riser diagram for the project area, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device and zones. Show door holder interface, elevator control interface, HVAC shutdown interface, Damper closure interface, and all other fire safety interfaces. Show all relevant network connection for the existing system on the riser. Show wiring Styles on the riser diagram for all SLC loops, NAC circuits and network loop circuits. Provide diagrams for the project area and interfaces with control equipment located on other floors as affected by this project.
4. Detailed wiring diagrams: Provide point to point wiring for NAC Extender Panels, Existing Field Panels, electrical power connections, modules, auxiliary relays and interconnection to the existing system, showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.
5. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.
6. Notification Appliance Circuit Voltage Drop Calculations: Provide calculated results for all circuits and provide the detailed voltage drop calculation for the worst case.
7. Sequence of Operations: Provide existing Facility Sequence of Operations demonstrating device and system response in Matrix format.

Call attention to any changes to the existing sequence necessary for the scope of this project.

8. Two weeks prior to final inspection, the Contractor shall deliver to the COTR one (1) set of reproducible, as-built drawings, two blue-line copies and one (1) set of the as-built drawing computer files using AutoCAD Release 2007. As-built drawings (floor plans) shall show all new and existing conduit used for the fire alarm system.

C. Manuals:

1. Submit simultaneously with the shop drawings, Equipment Submittal Cutsheets of each Fire Alarm System Device, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
 - a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.
 - b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
 - c. Include complete listing of all software used, existing software version and installation and operation instructions including the input/output matrix chart.
 - d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturer's installation limitations including but not limited to circuit length limitations.
 - e. Listing of all existing digitized voice messages.
 - f. Include information indicating who will provide emergency service and perform post contract maintenance.
 - g. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
 - h. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VAMC and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A print out of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.

- i. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.
 - k. A print out for all devices proposed on each signaling line circuit with spare capacity indicated.
 2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manual to the COTR.
 - a. The manual shall be updated to include any information necessitated by the maintenance and operating of the system.
 - b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.
 - c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.
 - d. Certificate of Installation as required by NFPA 72 for each project area. The certificate shall identify any variations from the National Fire Alarm Code.
 - e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.
- D. Certifications:
1. Together with the shop drawing submittal, submit the technician's NICET level III or IV fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.
 2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
 3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

1.5 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. Provide final As Built drawings to COTR in AutoCAD 2007 Format.

- B. The floor plans shall be marked in pen to include the following:
1. All device locations with labels.
 2. Conduit locations.
 3. Head-end equipment and specific location.
 4. Wiring diagram.
 5. Labeling and administration documentation.
 6. Warranty certificate.
 7. System test results.

1.6 WARRANTY

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of five (5) years from the date of acceptance of the entire installation by the Contracting Officer.

1.7 GUARANTY PERIOD SERVICES

- A. Complete inspection, testing, maintenance and repair service for the fire alarm system shall be provided by a factory trained authorized representative of the manufacturer of the major equipment for a period of five years from the date of acceptance of the entire installation by the Contracting Officer.
- B. Contractor shall provide all necessary test equipment, parts and labor to perform required inspection, testing, maintenance and repair.
- C. All inspection, testing, maintenance and permanent records required by NFPA 72, and recommended by the equipment manufacturer shall be provided by the contractor. Work shall include operation of sprinkler system alarm and supervisory devices as well as all reused existing equipment connected to the fire alarm system. It shall include all interfaced equipment including but not limited to elevators, HVAC shutdown, and extinguishing systems.
- D. Maintenance and testing shall be performed in accordance with NFPA 72. A computerized preventive maintenance schedule shall be provided and shall describe the protocol for preventive maintenance of equipment. The schedule shall include a systematic examination, adjustment and cleaning of all equipment.
- E. Non-included Work: Repair service shall not include the performance of any work due to improper use, accidents, or negligence for which the contractor is not responsible.
- F. Service and emergency personnel shall report to the Engineering Office or their authorized representative upon arrival at the hospital and again upon the completion of the required work. A copy of the Work Order

ticket containing a complete description of the work performed and parts replaced shall be provided to the VA Contracting Officer or his authorized representative.

G. Emergency Service:

1. Warranty Period Service: Service other than the preventative maintenance, inspection, and testing required by NFPA 72 shall be considered emergency call-back service and covered under the warranty of the installation during the first year of the warranty period, unless the required service is a result of abuse or misuse by the Government. Written notification shall not be required for emergency warranty period service and the contractor shall respond as outlined in the following sections on Normal and Overtime Emergency Call-Back Service. Warranty period service can be required during normal or overtime emergency call-back service time periods at the discretion of the Contracting Officer or his authorized representative.
2. Normal and overtime emergency call-back service shall consist of an on-site response within four hours of notification of a system trouble.
3. Normal emergency call-back service times are between the hours of 7:30 a.m. and 4:00 p.m., Monday through Friday, exclusive of federal holidays. Service performed during all other times shall be considered to be overtime emergency call-back service. The cost of all normal emergency call-back service for years 2 through 5 shall be included in the cost of this contract.
4. Overtime emergency call-back service shall be provided for the system when requested by the Government. The cost of the first 40 manhours per year of overtime call-back service during years 2 through 5 of this contract shall be provided under this contract. Payment for overtime emergency call-back service in excess of the 40 man hours per year requirement will be handled through separate purchase orders. The method of calculating overtime emergency call-back hours is based on actual time spent on site and does not include travel time.

H. The contractor shall maintain a log at each fire alarm control unit. The log shall list the date and time of all examinations and trouble calls, condition of the system, and name of the technician. Each trouble call shall be fully described, including the nature of the trouble, necessary correction performed, and parts replaced.

I. In the event that VA modifies the fire alarm system post-Acceptance but during the five year Guaranty Period Service period, Contractor shall be required to verify that the system, as newly modified or added, is

consistent with the manufacturer's requirements; any verification performed will be equitably adjusted under the Changes clause. The post-Acceptance modification or addition to the fire alarm system shall not void the continuing requirements under this contract set forth in the Guarantee Period Service provision for the fire alarm system as modified or added. The contract will be equitably adjusted under the Changes clause for such additional performance.

1.8 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only.
- B. National Fire Protection Association (NFPA):
 - 70-2008.....National Electrical Code (NEC).
 - 72-2007.....National Fire Alarm Code.
 - 90A-2009.....Installation of Air Conditioning and Ventilating Systems.
 - 101-2009.....Life Safety Code
- C. Underwriters Laboratories, Inc. (UL):
 - 2000-2000.....Fire Protection Equipment Directory
- D. Factory Mutual Research Corp (FM): Approval Guide, 2005 Edition
- E. American National Standards Institute (ANSI):
 - S3.41-1996.....Audible Emergency Evacuation Signal
- F. International Code Council, International Building Code (IBC) 2006 Edition
- G. International Code Council, International Fire Code (IFC) 2006 Edition

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS, GENERAL

- A. Existing equipment may be reused only where indicated on the drawings.
- B. Except as indicated in paragraph A above, All equipment and components shall be new, compatible with the existing system and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturers' requirements and that satisfactory total system operation has been achieved.
- C. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity or performance characteristics of items furnished in the System. When the Contractor furnishes an item of

equipment for which there is a specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.

2.2 CONDUIT, BOXES, AND WIRE

A. Conduit shall be in accordance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS and as follows:

1. All new and reused conduit shall be installed in accordance with NFPA 70.
2. Conduit fill shall not exceed 40 percent of interior cross sectional area.
3. All new conduit shall be 19 mm (3/4 inch) minimum.

B. Wire:

1. All existing wiring shall be removed and new wiring installed in a conduit or raceway.
2. Wiring shall be in accordance with NEC article 760, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.
3. Addressable circuits(SLC)and wiring used for the multiplex communication loop shall be twisted unless specifically excepted by the fire alarm equipment manufacturer in writing.
4. Speaker circuits shall be twisted unless specifically excepted by the fire alarm equipment manufacturer in writing.
5. Any fire alarm system wiring that extends outside of a building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.

C. Terminal Boxes, Junction Boxes, and Cabinets:

1. Shall be galvanized steel in accordance with UL requirements.
2. All new and reused boxes shall be sized and installed in accordance with NFPA 70.
3. New and existing covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 19 mm (3/4 inch) high.

4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
5. Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the COTR.

2.3 FIRE ALARM CONTROL UNIT

A. General:

1. The Fire Alarm Control Panel is existing.
2. All new Field Devices shall be compatible with the existing system.
3. All circuits shall be monitored for integrity.
4. Visually and audibly annunciate any trouble condition including, but not limited to main power failure, grounds and system wiring derangement.
5. Transmit digital alarm information to the existing main fire alarm control unit.
6. The door holder power shall be arranged so that momentary or sustained loss of main operating power shall not cause the release of any door.
7. Power supply for smoke detectors shall be taken from the fire alarm control unit.

B. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.

C. Supervisory Devices: All sprinkler system valves, standpipe control valves, post indicator valves (PIV), and main gate valves shall be supervised for off-normal position. Closing a valve shall sound a supervisory signal at the control unit until silenced by an off switch. The specific location of all closed valves shall be identified at the control unit. Valve operation shall not cause an alarm signal. Low air pressure switches and duct detectors shall be monitored as supervisory signals. The power supply to the elevator shunt trip breaker shall be monitored by the fire alarm system as a supervisory signal.

D. Trouble signals:

1. Arrange the trouble signals for automatic reset (non-latching).
2. System trouble switch off and on lamps shall be visible through the control unit door.

E. Remote Transmissions:

1. Provide capability and equipment for transmission of alarm, supervisory and trouble signals to the main fire alarm control unit.
2. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

F. Remote Control Capability: Each building fire alarm control unit shall be installed and programmed so that each must be reset locally after an alarm, before the main fire alarm control unit can be reset. After the local building fire alarm control unit has been reset, then the all system acknowledge, reset, silence or disabling functions can be operated by the main fire alarm control unit

2.4 STANDBY POWER SUPPLY

A. Batteries:

1. Battery shall be of the sealed, maintenance free type, 24-volt nominal.
2. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus five minutes of alarm to an end voltage of 1.14 volts per cell, upon a normal AC power failure.
3. Battery racks shall be steel with an alkali-resistant finish. Batteries shall be secured in seismic areas 2B, 3, or 4 as defined by the Uniform Building Code.

B. Battery Charger:

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120-volt, 60 hertz emergency power source.
2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
3. Shall have protection to prevent discharge through the charger.
4. Shall have protection for overloads and short circuits on both AC and DC sides.
5. A trouble condition shall actuate the fire alarm trouble signal.
6. Charger shall have automatic AC line voltage regulation, automatic current-limiting features, and adjustable voltage controls.

2.5 ANNUNCIATION

A. Annunciator, Alphanumeric Type (System):

1. existing, no additional required for this project.

2.6 VOICE COMMUNICATION SYSTEM (VCS)

A. General:

1. An emergency voice communication system shall be installed throughout the Emergency Department Project Area.
2. Upon receipt of an alarm signal from the building fire alarm system, the VCS shall automatically transmit the existing pre-recorded fire alarm message throughout the building.
3. A digitized voice module shall be used to store each prerecorded message.
4. The VCS and messaging are existing and the message shall be altered as necessary to include new smoke zones for this project.
5. The existing VCS shall supervise all speaker circuits, control equipment, remote audio control equipment, and amplifiers.

B. Speaker Circuit Control Unit:

1. The speaker circuit control unit and manual switches are existing and shall be reused for the scope of this project. Add speaker zone when necessary to conform with new Smoke Compartments.
2. New speakers for this project shall be connected to the zone designated for the floor and area where the new work will be performed.

C. Speaker Circuit Arrangement:

1. Speaker circuits shall be arranged such that there is one speaker circuit per smoke zone.
2. Audio amplifiers and control equipment supervision shall be maintained.
3. Speaker circuits shall be 25 VRMS with a minimum of 50% spare power available.
4. Speaker circuits and control equipment shall be arranged such that loss of any one speaker circuit will not cause the loss of any other speaker circuit in the system.

D. Digitized Voice Module (DVM):

1. The existing Digitized Voice Module shall not be affected by the scope of this project.

E. Audio Amplifiers:

1. Audio Amplifiers shall provide a minimum of 50 Watts at 25 VRMS output voltage levels.
2. Amplifiers shall be continuously supervised for operational status.
3. Amplifiers shall be configured for either single or dual channel application.
4. Each audio output circuit connection shall be configurable for Class B (abnormal condition 2).
5. A minimum of 50% spare output capacity shall be available for each amplifier.

F. Tone Generator(s):

1. Tone Generator(s) shall be capable of providing a distinctive three-pulse temporal pattern fire alarm signal as well as a slow whoop.
2. Tone Generator(s) shall be continuously supervised for operational status.

2.7 REMOTE BOOSTER POWER SUPPLY

A. General:

1. The remote Booster Power Supply is existing installed during Phase 1.
2. If due to voltage drop, additional circuits exceeding the 4 provided are required, additional Booster Power Supplies as necessary shall be installed to provide those additional circuits. Calculations per phase shall be submitted with the shop drawings.
3. All notification appliance circuits shall be monitored for integrity.

2.8 ALARM NOTIFICATION APPLIANCES

A. Speakers:

1. Shall operate on 25 VRMS with field selectable output taps from 0.5 to 2.0W and originally installed at the one-half watt tap. Speakers shall provide a minimum sound output of 80 dBA at ten feet with the one-half watt tap.
2. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
3. 100 mm (4 inches) or 200 mm (8 inches) cone type speakers ceiling mounted with white colored baffles in areas with suspended ceilings and wall mounted in areas without ceilings.
4. Speakers shall match existing currently installed throughout the facility.
5. Speakers shall provide a clear audible message to meet the requirements of intelligibility.

C. Strobes:

1. Xenon flash tube type with field adjustable candela settings with a flash rate of 1 HZ. Strobes provide candela ratings as required and shall be synchronized where required by the National Fire Alarm Code (NFPA 72).
2. Backplate shall be red with 13 mm (1/2 inch) permanent red letters. Lettering to read "Fire", be oriented on the wall or ceiling properly, and be visible from all viewing directions.
3. Each strobe circuit shall have a minimum of twenty (20) percent spare capacity.
4. Strobes may be combined with the audible notification appliances specified herein.
5. Strobes shall match existing currently installed throughout the facility.

6. Visual Notification Circuits shall be wired as a Class B (Style Y: 2002 NFPA 72) configuration.

2.9 ALARM INITIATING DEVICES

A. General

1. Automatic and Manual Alarm Initiating Devices shall be installed in the project as required.
2. Comply with requirements for Smoke Control.
3. Communication between the FACP and Alarm Initiating Devices shall be provided by existing Signaling Line Circuits.
4. All Alarm Initiating Devices shall be individually addressed.
5. Signaling Line Circuits shall be Class B Style 4.
6. Connection between monitor modules and dry contact devices shall be by Initiating Device Circuits.
7. Initiating Device Circuits shall be Class B.

A. Manual Fire Alarm Stations:

1. Shall be non-breakglass, address reporting type.
2. Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.
3. Stations shall be of double action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE".
4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
5. Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.

B. Smoke Detectors:

1. Smoke detectors shall be UL listed for use with the existing fire alarm control unit.
2. Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be installed in accordance with the manufacturer's recommendations and NFPA 72.
3. Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.

4. All spot type and duct type detectors installed shall be of the photoelectric type.
5. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
6. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.

C. Water Flow and Pressure Switches:

1. Wet pipe water flow switches and dry pipe alarm pressure switches for sprinkler systems shall be connected to the fire alarm system by way of an address reporting interface device.
2. All new water flow switches shall be of a single manufacturer and series and non-accumulative retard type. See Section 21 12 00, FIRE-SUPPRESSION STANDPIPES and Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches added. Connect all switches shown on the approved shop drawing.
3. All new switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Timing shall be recorded and documented during testing.

2.10 SUPERVISORY DEVICES

A. Duct Smoke Detectors:

1. Duct smoke detectors shall be provided and connected by way of an address reporting interface device. Detectors shall be provided with an approved duct housing mounted exterior to the duct, and shall have perforated sampling tubes extending across the full width of the duct (wall to wall). Detector placement shall be such that there is uniform airflow in the cross section of the duct.
2. Interlocking with fans shall be provided in accordance with NFPA 90A and as specified hereinafter under Part 3.2, "TYPICAL OPERATION".
3. Provide identification nameplates (e.g. "DUCT SMOKE DETECTOR AHU-X") for all duct detectors.

B. Sprinkler and Standpipe System Supervisory Switches:

1. Each sprinkler system water supply control valve, riser valve or zone control valve, and each standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.

2. Valve supervisory switches shall be connected to the fire alarm system by way of address reporting interface device. See Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches to be added. Connect tamper switches for all control valves shown on the approved shop drawings.
3. The mechanism shall be contained in a weatherproof die-cast aluminum housing that shall provide a 19 mm (3/4 inch) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.
4. The entire installed assembly shall be tamper-proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting.
5. Where dry-pipe sprinkler systems are installed, high and low air pressure switches shall be provided and monitored by way of an address reporting interface devices.

2.11 ADDRESS REPORTING INTERFACE DEVICE

- A. Shall have unique addresses that reports directly to the building fire alarm panel.
- B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.
- C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.
- D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.
- E. Coordinate the annunciator display location identification with the resident engineer before programming.

2.12 SMOKE BARRIER DOOR CONTROL

- A. Electromagnetic Door Holders:
 1. New Door Holders shall be standard wall mounted electromagnetic type. In locations where doors do not come in contact with the wall when in the full open position, an extension post shall be added to the door bracket.
 2. Operation shall be by 24 volt DC supplied from a battery located at the fire alarm control unit or Remote power supply. Door holders shall be coordinated as to voltage, ampere drain, and voltage drop with the battery, battery charger, wiring and fire alarm system for operation as specified.
- B. A maximum of twelve door holders shall be provided for each circuit. Door holders shall be wired to allow releasing doors by smoke zone.
- C. Door holder control circuits shall be electrically supervised.

- D. Smoke detectors shall not be incorporated as an integral part of door holders.

2.13 ADDRESS CONTROL OR RELAY DEVICE

- A. Shall have unique addresses that communicates directly to the building fire alarm panel.
- B. Shall be configurable to provide dry relay contacts or output functions.
- C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are controlling.
- D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.

2.14 UTILITY LOCKS AND KEYS:

- A. All key operated test switches, control units, annunciator panels and lockable cabinets shall be provided with a single standardized utility lock and key.
- B. Key-operated manual fire alarm stations shall have a single standardized lock and key separate from the control equipment.
- C. All keys shall be delivered to the COTR.

2.15 SPARE AND REPLACEMENT PARTS

- A. Provide spare and replacement parts as follows:
 - 1. Manual pull stations - 1
 - 2. Fire alarm strobes - 1
 - 3. Fire alarm speaker - 1
 - 4. Fire alarm speaker/strobes - 2
 - 5. Smoke detectors - 2
 - 6. Duct smoke detectors with all appurtenances - 1
 - 7. Control equipment keys - 4
 - 8. 2.5 oz containers aerosol smoke - 6
 - 9. Control modules - 1
 - 10. Fire alarm SLC cable (same as installed) - 152 m (500 feet)
- B. Spare and replacement parts shall be in original packaging and submitted to the COTR.
- C. Provide to the VA, all hardware, software, programming tools, license and documentation necessary to permanently modify the fire alarm system on site. The minimum level of modification includes addition and deletion of devices, circuits, zones and changes to system description, system operation, and digitized evacuation and instructional messages.

2.16 INSTRUCTION CHART:

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame with a backplate. Install the frame in a conspicuous location observable from each control unit where operations are performed. The card shall show those steps to be taken by an operator when a signal is received under all conditions, normal, alarm, supervisory, and trouble. Provide an additional copy with the binder for the input output matrix for the sequence of operation. The instructions shall be approved by the COTR before being posted.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS , Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.
- B. All new conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. All existing accessible fire alarm conduit not reused shall be removed.
- C. All new or reused exposed conduit shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.
- D. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and patched in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Restoration, and be re-painted in accordance with Section 09 91 00, PAINTING as necessary to match existing.
- E. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations to be approved by the COTR.
- F. Speakers shall be ceiling mounted and shall match existing installed in the Medical Center.

- G. Strobes shall be ceiling mounted and shall match existing installed in the Medical Center.
- H. Manual pull stations shall be installed not less than 1050 mm (42 inches) or more than 1200 mm (48 inches) from finished floor to bottom of device and within 1500 mm (60 inches) of a stairway or an exit door.
- I. Where possible, locate water flow and pressure switches a minimum of 300 mm (12 inches) from a fitting that changes the direction of the flow and a minimum of 900 mm (36 inches) from a valve.
- J. Mount valve tamper switches so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
- K. Connect flow and tamper switches installed under Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS.
- L. Provide addressable relays at equipment to be controlled.

3.2 TYPICAL OPERATION

- A. Activation of any manual pull station, water flow or pressure switch, heat detector, kitchen hood suppression system, gaseous suppression system, or smoke detector shall cause the following operations to occur:
 - 1. Operate the emergency voice communication system in Building 1.
Flash strobes continuously throughout Building 1.
 - 2. Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control unit in Buildings 1.
 - 3. Release only the magnetic door holders on the floor from which alarm was initiated.
 - 4. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
 - 5. Unlock the electrically locked exit doors within the zone of alarm.
- B. Operation of a smoke detector at a corridor door used for automatic closing shall also release the magnetic door holders on the floor.
- C. Operation of duct smoke detectors shall cause a system supervisory condition and shut down the ventilation system and close the associated smoke dampers as appropriate.
- D. Operation of any sprinkler or standpipe system valve supervisory switch, high/low air pressure switch, or fire pump alarm switch shall cause a system supervisory condition.

3.3 TESTS

- A. Provide the service of a NICET level III or IV, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during

all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COTR.

- B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COTR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm system meets all contract requirements. After the system has passed the initial test and been approved by the COTR, the contractor may request a final inspection.
1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
 3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
 4. Open each alarm initiating and notification circuit to see if trouble signal actuates.
 5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

3.4 FINAL INSPECTION AND ACCEPTANCE

- A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.
- B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

3.5 INSTRUCTION

- A. The manufacturer's authorized representative shall provide instruction and training to the VA as follows:
1. Three one-hour sessions to engineering staff, security police and central attendant personnel for simple operation of the system. Two sessions at the start of installation, two sessions at the completion

- of installation and two sessions 3 months after the completion of installation.
2. Two two-hour sessions to engineering staff for detailed operation of the system. Two sessions at the completion of installation and two sessions 3 months after the completion of installation.
 3. One eight-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation and one eight-hour refresher session 3 months after the completion of installation.
- B. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a trouble shooting guide of the entire system for submittal to the VA. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the system. The INPUT/OUTPUT matrix format shall be as shown in Appendix A to NFPA 72.
- C. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

PART 4 - SCHEDULES

4.1 SMOKE ZONE DESCRIPTIONS:

1. First Floor Southwest
2. First Floor Southeast

4.2 DIGITIZED VOICE MESSAGES:

- A. Digitized voice messages shall be provided for each smoke zone of Building 1. The messages shall be arranged with a 3 second alert tone, a "Code Red" message and a description of the fire alarm area (building number, floor, level and smoke zone). A sample of such a message is as follows:
- Alert Tone
- Code Red
- Building One, Second Floor, East Wing
- Code Red
- Building One, Second Floor, East Wing
- Code Red
- Building One, Second Floor, East Wing

4.3 LOCATION OF VOICE MESSAGES:

Upon receipt of an alarm signal from the building fire alarm system, the voice communication system shall automatically transmit a 3 second tone alert and a pre-recorded fire alarm message throughout the building.

- - - END - - -

SECTION 31 20 00

EARTH MOVING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:
1. Site preparation.
 2. Excavation.
 3. Underpinning.
 4. Filling and backfilling.
 5. Grading.
 6. Soil Disposal.
 7. Clean Up.

1.2 DEFINITIONS

- A. Unsuitable Materials:
1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D 698 or D 1557.
 2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
 3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from design requirements, excavate to acceptable strata subject to Resident Engineer's approval.
- B. Building Earthwork: Earthwork operations required in area enclosed by a line located 1500 mm (5 feet) outside of principal building perimeter. It also includes earthwork required for auxiliary structures and buildings.
- C. Trench Earthwork: Trenchwork required for utility lines.
- D. Site Earthwork: Earthwork operations required in area outside of a line located 1500 mm (5 feet) outside of principal building perimeter and within new construction area with exceptions noted above.
- E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through

use of data provided from results of field test procedures presented in ASTM D1556, ASTM D2167, and ASTM D2922.

- F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term "fill" means fill or backfill as appropriate.
- G. Backfill: Soil materials or controlled low strength material used to fill an excavation.
- H. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization by the Resident Engineer. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.
- I. Authorized additional excavation: Removal of additional material authorized by the Resident Engineer based on the determination by the Government's soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.
- J. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.
- K. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- N. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe. Bedding course shall extend up to the springline of the pipe.
- O. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.
- P. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- Q. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.
- R. Contaminated soils: Soil that contains contaminants as defined and determined by the Resident Engineer or the Government's testing agency.

1.3 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Furnish to Resident Engineer:
 - 1. Contactor shall furnish resumes with all personnel involved in the project including Project Manager, Superintendent, and on-site Engineer. Project Manager and Superintendent should have at least 3 years of experience on projects of similar size.
 - 2. Soil samples.
 - a. Classification in accordance with ASTM D2487 for each on-site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
 - b. Laboratory compaction curve in accordance with ASTM D 698 or D 1557 for each on site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
 - c. Test reports for compliance with ASTM D 2940 requirements for subbase material.
 - d. Pre-excavation photographs and videotape in the vicinity of the existing structures to document existing site features, including surfaces finishes, cracks, or other structural blemishes that might be misconstrued as damage caused by earthwork operations.
 - e. The Contractor shall submit a scale plan daily that defines the location, limits, and depths of the area excavated.

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 Association of State Highway and Transportation Officials (AASHTO):

T99-01(2004).....Moisture-Density Relations of Soils Using a
2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch)
Drop

T180-01(2004).....Moisture-Density Relations of Soils using a
4.54 kg (10 lb) Rammer and a 457 mm (18 inch)
Drop

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

D448-03a.....Standard Classification for Sizes of
Aggregate for Road and Bridge Construction

D698-00ae1.....Standard Test Methods for Laboratory
Compaction Characteristics of Soil Using
Standard Effort (12,400 ft. lbf/ft³ (600 kN
m/m³))

D1556-00.....Standard Test Method for Density and Unit
Weight of Soil in Place by the Sand-Cone
Method

D1557-02e1.....Standard Test Methods for Laboratory
Compaction Characteristics of Soil Using
Modified Effort (56,000 ft-lbf/ft³ (2700 kN
m/m³))

D2167-94 (2001).....Standard Test Method for Density and Unit
Weight of Soil in Place by the Rubber Balloon
Method

D2487-06.....Standard Classification of Soil for
Engineering Purposes (Unified Soil
Classification System)

D2922-05.....Standard Test Methods for Density of Soil and
Soil-Aggregate in Place by Nuclear Methods
(Shallow Depth)

D2940-03.....Standard Specifications for Graded Aggregate
Material for Bases or Subbases for Highways
or Airports

D. Society of Automotive Engineers (SAE):

J732-92.....Specification Definitions - Loaders

J1179-02.....Hydraulic Excavator and Backhoe Digging
Forces

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide borrow soil material when sufficient
satisfactory soil materials are not available from excavations.

- B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups; free of rock or gravel larger than 75 mm (3 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off site sources having a minimum dry density of 1760 kg/m³ (110 pcf), a maximum Plasticity Index of 15, and a maximum Liquid Limit of 40.
- C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups, or as approved by the Engineer or material with at least 90 percent passing a 37.5-mm (1 1/2-inch) sieve and not more than 12 percent passing a 75-µm (No. 200) sieve, per ASTM D2940;.
- D. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 25 mm (1 inch) sieve and not more than 8 percent passing a 75-µm (No. 200) sieve.
- E. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 37.5 mm (1 1/2-inch) sieve and 0 to 5 percent passing a 2.36 mm (No. 8) sieve.
- F. Granular Fill:
 - 1. Under concrete slab, crushed stone or gravel graded from 25 mm (1 inch) to 4.75 mm (No. 4), per ASTM D 2940.
 - 2. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No 4), per ASTM D 2940.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions. Remove materials from Medical Center.
- B. Grubbing: Remove stumps and roots 75 mm (3 inch) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inch) diameter, and nonperishable solid objects a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left.
- C. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from Medical Center.
- D. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.

1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
2. Locations of existing and proposed elevations indicated on plans are approximate. Proposed spot elevations and contour lines have been developed utilizing the existing conditions survey and developed contour lines and may be approximate. // Contractor is responsible to notify Resident Engineer of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify Resident Engineer of any differences between existing or constructed grades, as compared to those shown on the plans.

3.2 EXCAVATION:

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the Resident Engineer, banks of excavations to protect workers, banks, adjacent paving, structures, and utilities.
 1. Design of the temporary support of excavation system is the responsibility of the Contractor.
 2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the Resident Engineer.
 3. Extend shoring and bracing to a minimum of 1500 mm (5 feet) below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
 4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall underpin the existing foundation, and provide a concrete fill support under disturbed foundations, as directed by Resident Engineer, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by Resident Engineer.
- B. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with concrete or material approved by the Resident Engineer.
- C. Blasting: Not permitted.

D. Building Earthwork:

1. Excavation shall be accomplished as required by drawings and specifications.
2. Excavate foundation excavations to solid undisturbed subgrade.
3. Remove loose or soft materials to a solid bottom.
4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete poured separately from the footings.
5. Do not tamp earth for backfilling in footing bottoms, except as specified.
6. Slope grades to direct water away from excavations and to prevent ponding.

E. Trench Earthwork:

1. Utility trenches (except sanitary and storm sewer):
 - a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
 - b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
 - c. Support piping on undisturbed earth unless a mechanical support is shown.
 - d. Length of open trench in advance of piping laying shall not be greater than is authorized by Resident Engineer.
2. Sanitary and storm sewer trenches:
 - a. Trench width below a point 150 mm (6 inches) above top of pipe shall be 600 mm (24 inches) maximum for pipe up to and including 300 mm (12 inches) diameter, and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (12 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
 - b. Bed bottom quadrant of pipe on undisturbed soil or granular fill.
 - 1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.
 - 2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one sixth of pipe diameter below pipe to 300 mm (12 inches) above top of pipe. Place and tamp fill material by hand.

- c. Place and compact as specified remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
 - d. Use granular fill for bedding where rock or rocky materials are excavated.
- F. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 25 mm (1 inch). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements, and for inspections. Remove subgrade materials that are determined by Resident Engineer as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the contractor shall obtain samples of the material, under the direction of the Resident Engineer, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. Testing of the soil shall be performed by the VA Testing Laboratory. When unsuitable material is encountered and removed, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on volume in cut section only.
 - 1. Site Grading:
 - a. Provide a smooth transition between adjacent existing grades and new grades.
 - b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
 - c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:
 - 1) Lawn or Unpaved Areas: Plus or minus 25 mm (1 inch).
 - 2) Walks: Plus or minus 25 mm (1 inch).
 - 3) Pavements: Plus or minus 13 mm (1 inch).
 - d. Grading Inside Building Lines: Finish subgrade to a tolerance of 13 mm (1/2 inch) when tested with a 3000 mm (10 foot) straightedge.

3.3 UNDERPINNING

- A. Design of the underpinning system is the responsibility of the Contractor and is subject to review and approval by the Resident Engineer. Underpinning of existing building foundations, as

indicated on structural drawings, or where excavation undermines existing foundations, shall be accomplished in the following manner:

1. Make general excavation for new construction, where new foundations are to be below existing foundations, to elevation of new foundations (or sized stone subbase), maintaining a 45 degree sloped berm.
2. For underpinning pits, underpin existing wall foundations by excavating 1200 mm (4 feet) wide pits to depth shown on drawings skipping 3 sections at any one time so as to maintain support for wall at all times.
3. Underpin intervening sections one at a time; no adjacent sections shall be underpinned until concrete in adjacent sections shall have reached 20 MPa (2500 psi) strength and have been dry packed with non-shrink grout to obtain positive bearing. Sheet and brace underpinning pits if soil will not stand on a vertical cut during this operation, or as required for safety of workmen. Repack any voids behind sheeting to prevent sloughing which could cause settlement of existing foundations. Contractor performing this portion of work shall have been prequalified by Resident Engineer as having previously performed successfully this type of work or will demonstrate his capability for successfully performing this work. It shall be sole responsibility of the Contractor to guard against objectionable movement or settlement and to preserve integrity of existing structures.
4. The tip elevation of the underpinning pits shall be a minimum of 900 mm (3 feet) below the adjacent excavation elevation.
5. Subgrades at the tip of the underpinning pit shall be clean, dry, and free of debris and shall be observed by the Resident Engineer prior to concrete placement.
6. Concrete shall not be free fall greater than 3000 mm (10 feet) into the pit.

3.4 FILLING AND BACKFILLING:

- A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Borrow will be supplied at no additional cost to the Government. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, foundation drainage, and pipes coming in contact with backfill have been installed and work inspected and approved by Resident Engineer.
- B. Placing: Place materials in horizontal layers not exceeding 200 mm (8 inches) in loose depth for material compacted by heavy compaction equipment, and not more than 100 mm (4 inches) in loose depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full

length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.

- C. Compaction: Compact with approved tamping rollers, sheepsfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without prior approval of Resident Engineer. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 or ASTM D1557 as specified below:
1. Fills, Embankments, and Backfill
 - a. Under proposed structures, building slabs, steps, and paved areas, scarify and recompact top 300 mm (12 inches) of existing subgrade and each layer of backfill or fill material in accordance with ASTM D698 or not less than 95 percent.
 - b. Landscaped areas, top 400 mm (16 inches), ASTM D698 or D1557 Method A to not less than 85 percent.
 2. Natural Ground (Cut or Existing)
 - a. Under building slabs, steps and paved areas, top 150 mm (6 inches), ASTM D698 or D1557 Method A to not less than 95 percent.
 - b. Curbs, curbs and gutters, top 150 mm (6 inches), ASTM D698 or D1557 Method A to not less than 95 percent.
 - c. Under sidewalks, top 150 mm (6 inches), ASTM D698 or D1557 Method A to not less than 95 percent.

3.5 GRADING

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside building away from building walls for a minimum distance of 1800 mm (6 feet).
- D. Finish grade earth floors in pipe basements as shown to a level, uniform slope and leave clean.
- E. Finished grade shall be at least 150 mm (6 inches) below bottom line of window or other building wall openings unless greater depth is shown.

- F. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 150 mm (6 inches) unless otherwise shown.
- G. Finish subgrade in a condition acceptable to Resident Engineer at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.
- H. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL:

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.
- B. Place excess excavated materials suitable for fill and/or backfill on site where directed.
- C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- D. Segregate all excavated contaminated soil designated by the Resident Engineer from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

3.7 CLEAN UP

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from Medical Center.

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