
PROJECT SPECIFICATIONS

Repair Hot Water Lines – Phase III

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Project: 528A8-10-814



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**DEPARTMENT OF VETERANS AFFAIRS
VHA MASTER SPECIFICATIONS**

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

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

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COVER SHEET	
	<u>CIVIL</u>
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L1.2	Site Layout and Materials Plan and Site Details
L1.3	Site Grading and Drainage Plan
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**SECTION 01 00 00
GENERAL REQUIREMENTS**

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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 the construction of Phase III of the Hot and Chilled Water Lines Tunnel 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 Hyman Hayes Associates (Architect), Friedman Fisher Associates (MEP), Ryan-Biggs Associates (Structure), and Eberlin and Eberlin (Civil), 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. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the COR in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the COR.

- E. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.

- F. Prior to commencing work, general contractor shall provide proof that a OSHA 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.

G. 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.

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

1.2 STATEMENT OF BID ITEM(S)

- A. ITEM I, Replacement. Replacement of existing underground hot water and chilled water supply and return pipes that connect the main Medical Center to the chiller plant. New pipes are to be encased in a waterproof concrete tunnel. Work includes general construction, alterations, roads, walks, grading, drainage, mechanical and electrical work, utility systems, necessary removal of existing underground components, and certain other items.
- B. ALTERNATE NO.1: Provide a cost to increase entire tunnel width, per 1'-0" increment.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, 4 sets of specifications and drawings will be furnished.
- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense, from reproducible sepia prints furnished by Issuing Office. Such sepia prints shall be returned to the Issuing Office immediately after printing is completed.

1.4 CONSTRUCTION SECURITY REQUIREMENTS

A. Security Plan:

1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.

2. The General Contractor is responsible for assuring that all 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.

C. NOT USED

D. Key Control:

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

E. Document Control:

1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".

2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
4. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified". Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the Contracting Officer upon request.
5. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
6. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
7. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
8. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
 - a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
 - b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

F. Motor Vehicle Restrictions

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

1.5 FIRE SAFETY

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

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

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

2. National Fire Protection Association (NFPA):

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

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

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

70-2011.....National Electrical Code

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

3. Occupational Safety and Health Administration (OSHA):

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

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 Contracting Officer Technical Representative (COR) 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 COR 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 or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of fire retardant treated wood or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
 2. Install 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 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 COR.
- H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to COR.

- I. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- J. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- K. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers.
- L. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with COR. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the COR.
- M. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with COR.
- N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR. Obtain permits from facility COR at least 48 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR.
- 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.
- Q. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- R. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

- S. If required, submit documentation to the COR that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

1.6 OPERATIONS AND STORAGE AREAS

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the COR. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.
- B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the 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 COR, 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.
- D. Working space and space available for storing materials shall be as determined by the COR.
- E. Workmen 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 COR where required by limited working space.

1. Do not store materials and equipment in other than assigned areas.
2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.
3. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.

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

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

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

I. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2.1m (seven feet) minimum height, around the construction area as indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension

bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. Remove the fence when directed by COR.

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

1. Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.

2. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, Contractor shall make arrangements for pre-inspection of site with Fire Department or Company (Department of Veterans Affairs or municipal) whichever will be required to respond to an alarm from Contractor's employee or watchman.

K. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR.

1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the Medical Center Director's prior knowledge and written approval. EQUIPMENT FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS for additional requirements.

2. Contractor shall submit a request to interrupt any such services to COR, in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.

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

1.7 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR of buildings 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 COR.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of resilient flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:
1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of

Contractor to restore damage caused by Contractor's workmen in executing work of this contract.

D. Protection: Provide the following protective measures:

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

1.8 INFECTION PREVENTION MEASURES

- A. Implement the requirements of VAMC's Infection Control Risk Assessment (ICRA) team. ICRA Group may monitor dust in the vicinity of the construction work and require the Contractor to take corrective action immediately if the safe levels are exceeded.
- B. Establish and maintain a dust control program as part of the contractor's infection preventive measures in accordance with the guidelines provided by ICRA Group. Prior to start of work, prepare a plan detailing project-specific dust protection measures, including periodic status reports, and submit to COR and Facility ICRA team for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
 1. All personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.
- C. Medical center Infection Control personnel shall monitor for airborne disease (e.g. aspergillosis) as appropriate during construction. A baseline of conditions may be established by the medical center prior to the start of work and periodically during the construction stage to

determine impact of construction activities on indoor air quality. In addition:

1. The RE and VAMC Infection Control personnel shall review pressure differential monitoring documentation to verify that pressure differentials in the construction zone and in the patient-care rooms are appropriate for their settings. The requirement for negative air pressure in the construction zone shall depend on the location and type of activity. Upon notification, the contractor shall implement corrective measures to restore proper pressure differentials as needed.
 2. In case of any problem, the medical center, along with assistance from the contractor, shall conduct an environmental assessment to find and eliminate the source.
- D. In general, following preventive measures shall be adopted during construction to keep down dust and prevent mold.
1. Dampen debris to keep down dust and provide temporary construction partitions in existing structures where directed by COR. Blank off ducts and diffusers to prevent circulation of dust into occupied areas during construction.
 2. Do not perform dust producing tasks within occupied areas without the approval of the COR. For construction in any areas that will remain jointly occupied by the medical Center and Contractor's workers, the Contractor shall:
 - a. Provide dust proof, insulated with sound proofing temporary drywall construction barriers to completely separate construction from the operational areas of the hospital in order to contain dirt debris and dust. Barriers shall be sealed and made presentable on hospital occupied side. Install a self-closing rated door in a metal frame, commensurate with the partition, to allow worker access. Maintain negative air at all times. A fire retardant polystyrene, 6-mil thick or greater plastic barrier meeting local fire codes may be used where dust control is the only hazard, and an agreement is reached with the COR and Medical Center.
 - b. HEPA filtration is required where the exhaust dust may reenter the breathing zone. Contractor shall verify that construction exhaust

to exterior is not reintroduced to the medical center through intake vents, or building openings. Install HEPA (High Efficiency Particulate Accumulator) filter vacuum system rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. Insure continuous negative air pressures occurring within the work area. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Exhaust hoses shall be heavy duty, flexible steel reinforced and exhausted so that dust is not reintroduced to the medical center.

- c. Adhesive Walk-off/Carpet Walk-off Mats, minimum 600mm x 900mm (24" x 36"), shall be used at all interior transitions from the construction area to occupied medical center area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.
- d. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as they are created. Transport these outside the construction area in containers with tightly fitting lids.
- e. The contractor shall not haul debris through patient-care areas without prior approval of the COR and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.
- f. Using a HEPA vacuum, clean inside the barrier and vacuum ceiling tile prior to replacement. Any ceiling access panels opened for investigation beyond sealed areas shall be sealed immediately when unattended.
- g. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up

and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.

- h. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.

E. Final Cleanup:

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

1.9 DISPOSAL AND RETENTION

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

1. Reserved items which are to remain property of the Government are noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by COR.
2. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center.
3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans Affairs during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.

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

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

1.11 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone)

which are indicated on drawings and which are not scheduled for discontinuance or abandonment.

- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.12 NOT USED.

1.13 PROFESSIONAL SURVEYING SERVICES

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

1.14 LAYOUT OF WORK

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

(FAR 52.236-17)

- B. Establish and plainly mark center lines for each building and/or addition to each existing building, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition,

roads, parking lots, are in accordance with lines and elevations shown on contract drawings.

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

bearing the registered land surveyor or registered civil engineer seal, and forward these drawings upon completion of work to COR.

- F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.15 AS-BUILT DRAWINGS

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

1.16 USE OF ROADWAYS

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

1.17 NOT USED

1.18 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to compliance with the following provisions:
1. Permission to use each unit or system must be given by COR. If the equipment is not installed and maintained in accordance with the following provisions, the COR will withdraw permission for use of the equipment.
 2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their overload elements shall be properly sized, coordinated and adjusted. Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.
 3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.
 4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage.
 5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.
 6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government. Boilers, pumps, feedwater heaters and auxiliary equipment must be operated as a complete system and be fully maintained by operating personnel. Boiler water must be given complete and continuous chemical treatment.

- 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.

1.19 NOT USED**1.20 NOT USED.****1.21 TEMPORARY TOILETS**

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

1.22 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.
- C. Contractor shall install meters at Contractor's expense and furnish the Medical Center a monthly red of the Contractor's usage of electricity as hereinafter specified.

- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:
1. Obtain heat by connecting to Medical Center heating distribution system.
 - a. Steam is available at no cost to Contractor.
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
1. Obtain electricity by connecting to the Medical Center electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.
- F. Water (for Construction and Testing): Furnish temporary water service.
1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection. Water is available at no cost to the Contractor.
 2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR's discretion) of use of water from Medical Center's system.
- G. Steam: Furnish steam system for testing required in various sections of specifications.
1. Obtain steam for testing by connecting to the Medical Center steam distribution system. Steam is available at no cost to the Contractor.
 2. Maintain connections, pipe, fittings and fixtures and conserve steam-use so none is wasted. Failure to stop leakage or other waste will be cause for revocation (at COR's discretion), of use of steam from the Medical Center's system.

- H. Fuel: Natural and LP gas and burner fuel oil required for boiler cleaning, normal initial boiler-burner setup and adjusting, and for performing the specified boiler tests will be furnished by the Government. Fuel required for prolonged boiler-burner setup, adjustments, or modifications due to improper design or operation of boiler, burner, or control devices shall be furnished by the Contractor at Contractor's expense.

1.23 NEW TELEPHONE EQUIPMENT

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

1.24 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 red 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.

1.25 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 COR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.
- C. Instructions: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system, shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions

for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the COR and shall be considered concluded only when the COR is satisfied in regard to complete and thorough coverage. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.26 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. Contractor shall be prepared to receive this equipment from Government and store or place such equipment not less than 90 days before Completion Date of project.
- D. Notify Contracting Officer in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.
 - 1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
 - 2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.
- E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make

the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.

- F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.
- G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

1.27 RELOCATED EQUIPMENT AND ITEMS

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated by symbol "R" or otherwise shown to be relocated by the Contractor.
- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the COR.
- C. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".
- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.
- E. NOT USED.
- F. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

1.28 NOT USED.

1.29 CONSTRUCTION SIGN

- A. Provide a Construction Sign where directed by the COR. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings.

Provide three 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 1200 mm (four feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50 x 100 mm (two by four inch) material as directed.

- B. Paint all surfaces of sign and posts two coats of white gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.
- C. Maintain sign and remove it when directed by the COR.
- D. Detail Drawing of construction sign showing required legend and other characteristics of sign is attached hereto and made a part of this specification.

1.30 SAFETY SIGN

- A. Provide a Safety Sign where directed by COR. Face of sign shall be 19 mm (3/4 inch) thick exterior grade plywood. Provide two 100 mm by 100 mm (four by four inch) posts extending full height of sign and 900 mm (three feet) into ground. Set bottom of sign level at 1200 mm (four feet) above ground.
- B. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.
- C. Maintain sign and remove it when directed by COR.
- D. Standard Detail Drawing Number SD10000-02(Found on VA TIL) of safety sign showing required legend and other characteristics of sign is attached hereto and is made a part of this specification.
- E. Post the number of accident free days on a daily basis.

1.31 PHOTOGRAPHIC DOCUMENTATION

- A. During the construction period through completion, provide photographic documentation of construction progress and at selected milestones including electronic indexing, navigation, storage and remote access to the documentation, as per these specifications. The commercial photographer or the subcontractor used for this work shall meet the following qualifications:

1. Demonstrable minimum experience of three (3) years in operation providing documentation and advanced indexing/navigation systems including a representative portfolio of construction projects of similar type, size, duration and complexity as the Project.
2. Demonstrable ability to service projects throughout North America, which shall be demonstrated by a representative portfolio of active projects of similar type, size, duration and complexity as the Project.

B. Photographic documentation elements:

1. Each digital image shall be taken with a professional grade camera with minimum size of 6 megapixels (MP) capable of producing 200x250mm (8 x 10 inch) prints with a minimum of 2272 x 1704 pixels and 400x500mm (16 x 20 inch) prints with a minimum 2592 x 1944 pixels.
2. Indexing and navigation system shall utilize actual AUTOCAD construction drawings, making such drawings interactive on an on-line interface. For all documentation referenced herein, indexing and navigation must be organized by both time (date-stamped) and location throughout the project.
3. Documentation shall combine indexing and navigation system with inspection-grade digital photography designed to capture actual conditions throughout construction and at critical milestones. Documentation shall be accessible on-line through use of an internet connection. Documentation shall allow for secure multiple-user access, simultaneously, on-line.
4. Before construction, the building pad, adjacent streets, roadways, parkways, driveways, curbs, sidewalks, landscaping, adjacent utilities and adjacent structures surrounding the building pad and site shall be documented. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings. If site work or pad preparation is extensive, this documentation may be required immediately before construction and at several pre-determined intervals before building work commences.
5. Construction progress for all trades shall be tracked at pre-determined intervals, but not less than once every thirty (30) calendar days ("Progressions"). Progression documentation shall

- track both the exterior and interior construction of the building. Exterior Progressions shall track 360 degrees around the site and each building. Interior Progressions shall track interior improvements beginning when stud work commences and continuing until Project completion.
6. As-built condition of pre-slab utilities and site utilities shall be documented prior to pouring slabs, placing concrete and/or backfilling. This process shall include all underground and in-slab utilities within the building(s) envelope(s) and utility runs in the immediate vicinity of the building(s) envelope(s). This may also include utilities enclosed in slab-on-deck in multi-story buildings. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive site utility plans.
 7. As-built conditions of mechanical, electrical, plumbing and all other systems shall be documented post-inspection and pre-insulation, sheet rock or dry wall installation. This process shall include all finished systems located in the walls and ceilings of all buildings at the Project. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings.
 8. As-built conditions of exterior skin and elevations shall be documented with an increased concentration of digital photographs as directed by the COR in order to capture pre-determined focal points, such as waterproofing, window flashing, radiused steel work, architectural or Exterior Insulation and Finish Systems (EIFS) detailing. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive elevations or elevation details.
 9. As-built finished conditions of the interior of each building including floors, ceilings and walls shall be documented at certificate of occupancy or equivalent, or just prior to occupancy, or both, as directed by the COR. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings.
 10. Miscellaneous events that occur during any Contractor site visit, or events captured by the Department of Veterans Affairs independently,

- shall be dated, labeled and inserted into a Section in the navigation structure entitled "Slideshows," allowing this information to be stored in the same "place" as the formal scope.
11. Customizable project-specific digital photographic documentation of other details or milestones. Indexing and navigation accomplished through interactive architectural plans.
 12. Monthly (29 max) exterior progressions (360 degrees around the project) and slideshows (all elevations and building envelope). The slideshows allow for the inclusion of Department of Veterans Affairs pictures, aerial photographs, and timely images which do not fit into any regular monthly photopath.
 13. Weekly (21 Max) Site Progressions - Photographic documentation capturing the project at different stages of construction. These progressions shall capture underground utilities, excavation, grading, backfill, landscaping and road construction throughout the duration of the project.
 14. Regular (8 max) interior progressions of all walls of the entire project to begin at time of substantial framed or as directed by the COR through to completion.
 15. Detailed Exact-Built of all Slabs for all project slab pours just prior to placing concrete or as directed by the COR.
 16. Detailed Interior exact built overlapping photos of the entire building to include documentation of all mechanical, electrical and plumbing systems in every wall and ceiling, to be conducted after rough-ins are complete, just prior to insulation and or drywall, or as directed by COR.
 17. Finished detailed Interior exact built overlapping photos of all walls, ceilings, and floors to be scheduled by COR prior to occupancy.
 18. In event a greater or lesser number of images than specified above are required by the COR, adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).

- C. Images shall be taken by a commercial photographer and must show distinctly, at as large a scale as possible, all parts of work embraced in the picture.
- D. Coordination of photo shoots is accomplished through COR. Contractor shall also attend construction team meetings as necessary. Contractor's operations team shall provide regular updates regarding the status of the documentation, including photo shoots concluded, the availability of new Progressions or Exact-Builts viewable on-line and anticipated future shoot dates.
- E. Contractor shall provide all on-line domain/web hosting, security measures, and redundant server back-up of the documentation.
- F. Contractor shall provide technical support related to using the system or service.
- G. Upon completion of the project, final copies of the documentation (the "Permanent Record") with the indexing and navigation system embedded (and active) shall be provided in an electronic media format, typically a DVD or external hard-drive. Permanent Record shall have Building Information Modeling (BIM) interface capabilities. On-line access terminates upon delivery of the Permanent Record.

1.32 NOT USED.

1.33 NOT USED.

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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.

1.2 CONTRACTOR'S REPRESENTATIVE:

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

1.3 CONTRACTOR'S CONSULTANT:

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

have their scheduling consultant approved prior to submitting any schedule for approval.

1.4 COMPUTER PRODUCED SCHEDULES

- A. The contractor shall provide monthly, to the Department of Veterans Affairs (VA), all computer-produced time/cost schedules and reports generated from monthly project updates. This monthly computer service will include: three copies of up to 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 COR 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 be responsible for the accurate and timely submittal of the updated project schedule and all CPM data necessary to produce the computer reports and payment request that is specified.
- C. The VA will report errors in computer-produced reports to the Contractor's representative within 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.

1.5 THE COMPLETE PROJECT SCHEDULE SUBMITTAL

- A. Within 45 calendar days after receipt of Notice to Proceed, the Contractor shall submit for the Contracting Officer's review; three blue line copies of the interim schedule on sheets of paper 765 x 1070 mm (30 x 42 inches) and an electronic file in the previously approved CPM schedule program. The submittal shall also include three copies of a computer-produced activity/event ID schedule showing project duration; phase completion dates; and other data, including event cost. Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, activity/event description, duration, budget amount, early start date, early finish date, late start date, late finish date and total float. Work activity/event relationships shall be restricted to finish-to-start or start-to-start without lead or lag constraints. Activity/event date constraints, not required by the contract, will not be accepted unless

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

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

1.6 WORK ACTIVITY/EVENT COST DATA

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

1.7 PROJECT SCHEDULE REQUIREMENTS

- A. Show on the project schedule the sequence of work activities/events required for complete performance of all items of work. The Contractor Shall:
 - 1. Show activities/events as:
 - a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
 - b. Contracting Officer's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
 - c. Interruption of VA Facilities utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.

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

- D. Compact Disk Requirements and CPM Activity/Event Record Specifications:
Submit to the VA an electronic file(s) containing one file of the data required to produce a schedule, reflecting all the activities/events of the complete project schedule being submitted.

1.8 PAYMENT TO THE CONTRACTOR:

- A. Monthly, the contractor shall submit the AIA application and certificate for payment documents G702 & G703 reflecting updated schedule activities and cost data in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, FAR 52.232 - 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.236 - 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS). The Contractor shall be entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated project schedule. Monthly payment requests shall include: a listing of all agreed upon project schedule changes and associated data; and an electronic file (s) of the resulting monthly updated schedule.
- B. Approval of the Contractor's monthly Application for Payment shall be contingent, among other factors, on the submittal of a satisfactory monthly update of the project schedule.

1.9 PAYMENT AND PROGRESS REPORTING

- A. Monthly schedule update meetings will be held on dates mutually agreed to by the COR and the Contractor. Contractor and their CPM consultant (if applicable) shall attend all monthly schedule update meetings. The Contractor shall accurately update the Project Schedule and all other data required and provide this information to the COR 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 COR for the contract change(s). When there is a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the COR. After each rerun update, the resulting electronic project schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.4 and 1.7. This electronic submission is separate from the regular monthly project schedule update requirements and shall be submitted to the COR 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.

1.10 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 COR for the proposed schedule changes. If such actions are approved, the representative schedule revisions shall be incorporated by the Contractor into the Project Schedule before the next update, at no additional cost to the Government.

1.11 CHANGES TO THE SCHEDULE

- A. Within 30 calendar days after VA acceptance and approval of any updated project schedule, the Contractor shall submit a revised electronic file (s) and a list of any activity/event changes including predecessors and successors for any of the following reasons:
 - 1. Delay in completion of any activity/event or group of activities/events, which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the CPM as the direct cause for delaying the project beyond the acceptable limits.
 - 2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
 - 3. The schedule does not represent the actual prosecution and progress of the project.
 - 4. When there is, or has been, a substantial revision to the activity/event costs regardless of the cause for these revisions.
- B. CPM revisions made under this paragraph which affect the previously approved computer-produced schedules for Government furnished equipment, vacating of areas by the VA Facility, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or

any other previously contracted item, shall be furnished in writing to the 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.

1.12 ADJUSTMENT OF CONTRACT COMPLETION

- A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, CPM data and supporting evidence as the COR may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in 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
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- 1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- 1-2. For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1-3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
 - A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
 - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
 - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1-4. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.
- 1-5. Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by COR on behalf of the Contracting Officer.
- 1-6. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.
- 1-7. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional

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

- 1-8. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect-Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- 1-9. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
 - A. Submit samples required by Section 09 06 00, SCHEDULE FOR FINISHES, in quadruplicate. Submit other samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
 - B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail or email and shall contain the list of items, name of Medical Center, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
 1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.
 2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Medical Center, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
 3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.

- C. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
 2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
 3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.
 4. Contractor shall send a copy of transmittal letter to both COR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
 5. Laboratory test reports shall be sent directly to COR for appropriate action.
 6. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
 7. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.
- D. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.
- E. Approved samples will be kept on file by the COR at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not

requested for return by Contractor will be discarded after completion of contract.

- F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.
 - 1. For each drawing required, submit one legible photographic paper or vellum reproducible.
 - 2. Reproducible shall be full size.
 - 3. Each drawing shall have marked thereon, proper descriptive title, including Medical Center location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
 - 4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
 - 5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
 - 6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
 - 7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.
- 1-10. Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

Michael Wotzak, Hyman Hayes Associates
(Architect-Engineer)

6 Wembley Court, Albany, NY 12205
(A/E P.O. Address, City, State and Zip Code)

MWOTZAK@HYMANHAYES.COM
(Email Contact)

- 1-11. At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the COR.
 - 1-12. Samples (except laboratory samples) for approval shall be sent to Architect-Engineer, in care of COR, VA Medical Center,
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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

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

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

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

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

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

AA Aluminum Association Inc.
<http://www.aluminum.org>

AABC Associated Air Balance Council
<http://www.aabchq.com>

AAMA American Architectural Manufacturer's Association
<http://www.aamanet.org>

AAN American Nursery and Landscape Association
<http://www.anla.org>

AASHTO American Association of State Highway and Transportation Officials
<http://www.aashto.org>

AATCC American Association of Textile Chemists and Colorists
<http://www.aatcc.org>

ACGIH American Conference of Governmental Industrial Hygienists
<http://www.acgih.org>

ACI American Concrete Institute
<http://www.aci-int.net>

ACPA American Concrete Pipe Association
<http://www.concrete-pipe.org>

ACPPA American Concrete Pressure Pipe Association
<http://www.acppa.org>

ADC Air Diffusion Council
<http://flexibleduct.org>

AGA American Gas Association
<http://www.aga.org>

AGC Associated General Contractors of America
<http://www.agc.org>

AGMA American Gear Manufacturers Association, Inc.
<http://www.agma.org>

AHAM Association of Home Appliance Manufacturers
<http://www.aham.org>

AISC American Institute of Steel Construction
<http://www.aisc.org>

AISI American Iron and Steel Institute
<http://www.steel.org>

AITC American Institute of Timber Construction
<http://www.aitc-glulam.org>

AMCA Air Movement and Control Association, Inc.
<http://www.amca.org>

ANLA American Nursery & Landscape Association
<http://www.anla.org>

ANSI American National Standards Institute, Inc.
<http://www.ansi.org>

APA The Engineered Wood Association
<http://www.apawood.org>

ARI Air-Conditioning and Refrigeration Institute
<http://www.ari.org>

ASAE American Society of Agricultural Engineers
<http://www.asae.org>

ASCE American Society of Civil Engineers
<http://www.asce.org>

ASHRAE American Society of Heating, Refrigerating, and
Air-Conditioning Engineers
<http://www.ashrae.org>

ASME American Society of Mechanical Engineers
<http://www.asme.org>

ASSE American Society of Sanitary Engineering
<http://www.asse-plumbing.org>

ASTM American Society for Testing and Materials
<http://www.astm.org>

AWI Architectural Woodwork Institute
<http://www.awinet.org>

AWS American Welding Society
<http://www.aws.org>

AWWA American Water Works Association
<http://www.awwa.org>

BHMA Builders Hardware Manufacturers Association
<http://www.buildershardware.com>

BIA Brick Institute of America
<http://www.bia.org>

CAGI Compressed Air and Gas Institute
<http://www.cagi.org>

CGA Compressed Gas Association, Inc.
<http://www.cganet.com>

CI The Chlorine Institute, Inc.
<http://www.chlorineinstitute.org>

CISCA Ceilings and Interior Systems Construction Association
<http://www.cisca.org>

CISPI Cast Iron Soil Pipe Institute
<http://www.cispi.org>

CLFMI Chain Link Fence Manufacturers Institute
<http://www.chainlinkinfo.org>

CPMB Concrete Plant Manufacturers Bureau
<http://www.cpmb.org>

CRA California Redwood Association
<http://www.calredwood.org>

CRSI Concrete Reinforcing Steel Institute
<http://www.crsi.org>

CTI Cooling Technology Institute
<http://www.cti.org>

DHI Door and Hardware Institute
<http://www.dhi.org>

EGSA Electrical Generating Systems Association
<http://www.egsa.org>

EEI Edison Electric Institute
<http://www.eei.org>

EPA Environmental Protection Agency
<http://www.epa.gov>

ETL ETL Testing Laboratories, Inc.
<http://www.etl.com>

FAA Federal Aviation Administration
<http://www.faa.gov>

FCC Federal Communications Commission
<http://www.fcc.gov>

FPS The Forest Products Society
<http://www.forestprod.org>

GANA Glass Association of North America
<http://www.cssinfo.com/info/gana.html/>

FM Factory Mutual Insurance
<http://www.fmglobal.com>

GA Gypsum Association
<http://www.gypsum.org>

GSA General Services Administration
<http://www.gsa.gov>

HI Hydraulic Institute
<http://www.pumps.org>

HPVA Hardwood Plywood & Veneer Association
<http://www.hpva.org>

ICBO International Conference of Building Officials
<http://www.icbo.org>

ICEA Insulated Cable Engineers Association Inc.
<http://www.icea.net>

\ICAC Institute of Clean Air Companies
<http://www.icac.com>

IEEE Institute of Electrical and Electronics Engineers
<http://www.ieee.org>

IMSA International Municipal Signal Association
<http://www.imsasafety.org>

IPCEA Insulated Power Cable Engineers Association

NBMA Metal Buildings Manufacturers Association
<http://www.mbma.com>

MSS Manufacturers Standardization Society of the Valve and Fittings Industry Inc.
<http://www.mss-hq.com>

NAAMM National Association of Architectural Metal Manufacturers
<http://www.naamm.org>

NAPHCC Plumbing-Heating-Cooling Contractors Association
<http://www.phccweb.org>

NBS National Bureau of Standards
See - NIST

NBBPVI National Board of Boiler and Pressure Vessel Inspectors
<http://www.nationboard.org>

NEC National Electric Code
See - NFPA National Fire Protection Association

NEMA National Electrical Manufacturers Association
<http://www.nema.org>

NFPA National Fire Protection Association
<http://www.nfpa.org>

NHLA National Hardwood Lumber Association
<http://www.natlhardwood.org>

NIH National Institute of Health
<http://www.nih.gov>

NIST National Institute of Standards and Technology
<http://www.nist.gov>

NLMA Northeastern Lumber Manufacturers Association, Inc.
<http://www.nelma.org>

NPA National Particleboard Association
18928 Premiere Court
Gaithersburg, MD 20879
(301) 670-0604

NSF National Sanitation Foundation
<http://www.nsf.org>

NWWDA Window and Door Manufacturers Association
<http://www.nwwda.org>

OSHA Occupational Safety and Health Administration
Department of Labor
<http://www.osha.gov>

PCA Portland Cement Association
<http://www.portcement.org>

PCI Precast Prestressed Concrete Institute
<http://www.pci.org>

PPI The Plastic Pipe Institute
<http://www.plasticpipe.org>

PEI Porcelain Enamel Institute, Inc.
<http://www.porcelainenamel.com>

PTI Post-Tensioning Institute
<http://www.post-tensioning.org>

RFCI The Resilient Floor Covering Institute
<http://www.rfci.com>

RIS Redwood Inspection Service
See - CRA

RMA Rubber Manufacturers Association, Inc.
<http://www.rma.org>

SCMA Southern Cypress Manufacturers Association
<http://www.cypressinfo.org>

SDI Steel Door Institute
<http://www.steeldoor.org>

IGMA Insulating Glass Manufacturers Alliance
<http://www.igmaonline.org>

SJI Steel Joist Institute
<http://www.steeljoist.org>

SMACNA Sheet Metal and Air-Conditioning Contractors
National Association, Inc.
<http://www.smacna.org>

SSPC The Society for Protective Coatings
<http://www.sspc.org>

STI Steel Tank Institute
<http://www.steeltank.com>

SWI Steel Window Institute
<http://www.steelwindows.com>

TCA Tile Council of America, Inc.
<http://www.tileusa.com>

TEMA Tubular Exchange Manufacturers Association
<http://www.tema.org>

TPI Truss Plate Institute, Inc.
583 D'Onofrio Drive; Suite 200
Madison, WI 53719
(608) 833-5900

UBC The Uniform Building Code
See ICBO

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

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

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

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

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

- - - E N D - - -

SECTION 01 45 29

SPECIAL INSPECTIONS AND TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies materials testing activities and special inspection services required during project construction to be provided by a Special Inspector and Testing Laboratory retained by Department of Veterans Affairs.
- B. Special Inspections and Structural Testing shall be in accordance with Chapter 17 of the *Building Code of New York State* (BCNYS).
- C. Hold a Special Inspections preconstruction meeting at least 7 days prior to initial planned date for start of construction.
 - 1. Discussions shall include the following:
 - a. Review of specifications and Schedule of Special Inspections for work requiring Special Inspections.
 - b. Responsibilities of Contractor, Owner, Testing Agency, Special Inspector, and Registered Design Professional.
 - c. Notification and reporting procedures.
 - 2. Attendees shall include Contractor, Owner's Representative, Testing Agency, Special Inspector, and Registered Design Professionals for Structural Engineering and for Architecture.

1.2 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - T27-11.....Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
 - T96-02 (R2006).....Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - T99-10.....Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
 - T104-99 (R2007).....Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
 - T180-10.....Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

- T191-02 (R2006).....Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method
- C. American Concrete Institute (ACI): Refer to the Schedule of Special Inspections.
- D. American Society for Testing and Materials (ASTM):
- A325-10.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- A370-12.....Standard Test Methods and Definitions for Mechanical Testing of Steel Products
- C31/C31M-10.....Standard Practice for Making and Curing Concrete Test Specimens in the Field
- C33/C33M-11a.....Standard Specification for Concrete Aggregates
- C39/C39M-12.....Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C109/C109M-11b.....Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
- C136-06.....Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C138/C138M-10b.....Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- C140-12.....Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
- C143/C143M-10a.....Standard Test Method for Slump of Hydraulic Cement Concrete
- C172/C172M-10.....Standard Practice for Sampling Freshly Mixed Concrete
- C173/C173M-10b.....Standard Test Method for Air Content of freshly Mixed Concrete by the Volumetric Method
- C780-11.....Standard Test Method for Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
- C1019-11.....Standard Test Method for Sampling and Testing Grout
- C1064/C1064M-11.....Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete

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

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

D698-07e1.....Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Standard Effort

D1140-00 (2006).....Standard Test Methods for Amount of Material in
Soils Finer than No. 200 Sieve

D1188-07e1.....Standard Test Method for Bulk Specific Gravity
and Density of Compacted Bituminous Mixtures
Using Coated Samples

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

D1557-09.....Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Modified Effort
(56,000ft lbf/ft³ (2,700 KNm/m³))

D2166-06.....Standard Test Method for Unconfined Compressive
Strength of Cohesive Soil

D2167-08).....Standard Test Method for Density and Unit
Weight of Soil in Place by the Rubber Balloon
Method

D2216-10.....Standard Test Methods for Laboratory
Determination of Water (Moisture) Content of
Soil and Rock by Mass

D3666-11.....Standard Specification for Minimum Requirements
for Agencies Testing and Inspecting Road and
Paving Materials

D3740-11.....Standard Practice for Minimum Requirements for
Agencies Engaged in Testing and/or Inspection
of Soil and Rock as used in Engineering Design
and Construction

D6938-10.....Standard Test Method for In-Place Density and
Water Content of Soil and Soil-Aggregate by
Nuclear Methods (Shallow Depth)

E94-04 (2010).....Standard Guide for Radiographic Examination

E164-08.....Standard Practice for Contact Ultrasonic
Testing of Weldments

E329-11c.....Standard Specification for Agencies Engaged in
Construction Inspection, Testing, or Special
Inspection

E543-09.....Standard Specification for Agencies Performing
Non-Destructive Testing

E709-08.....Standard Guide for Magnetic Particle
Examination

E. American Welding Society (AWS):

D1.D1.1M-10.....Structural Welding Code-Steel

Refer to the Schedule of Special Inspections for additional standards.

1.3 REQUIREMENTS:

- A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E329, C1077, D3666, D3740, A880, E543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by 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.
- E. Special Inspector and Testing/Inspecting Agency shall be accepted by the Registered Design Professional (RDP) and the Code Enforcement Official.
- F. Special Inspections shall be performed by agents who have relevant experience for each category of inspections indicated in the drawings.

- G. Minimum qualifications of inspection agents are indicated in the drawings.

1.4 DEFINITIONS:

- A. Registered Design Professional: Licensed Professional Engineer or Registered Architect whose seal appears in the Construction Drawings. Unless noted otherwise, references to the Registered Design Professional in this section refer to the Structural Engineer for building design.
- B. Code Enforcement Official: Officer or other designated authority charged with administration and enforcement of the BCNYS.
- C. Testing/Inspecting Agency: Agent retained by Special Inspector or Owner and coordinated by Special Inspector to perform some inspection services on behalf of Special Inspector. A Geotechnical Engineer is an example of an Inspecting Agent.
- D. Statement of Special Inspections: Documents prepared by the Registered Design Professional and filed with and approved by the Code Enforcement Official, listing materials and work requiring Special Inspections. These documents include this specification and the Schedule of Special Inspections.
- E. Schedule of Special Inspections: An itemized list of inspections, verifications, and tests (including frequency) required for the project and individuals, agencies, or firms who will be retained to perform these services. The Schedule of Special Inspections is located in Drawing SO.2.
- F. Continuous Special Inspection: Full-time observation of work by the Special Inspector or Testing Agency while the work is being performed.
- G. Periodic Special Inspections: Part-time or intermittent observation of work by the Special Inspector or Testing Agency for work that has been or is being performed and at completion of the work.

1.5 SUBMITTALS:

- A. Special Inspector and Testing/Inspecting Agency shall submit to the Registered Design Professional and Code Enforcement Official for review, a copy of their qualifications including names and qualifications of each inspector and technician who will be performing inspections or tests.
- B. Special Inspector and Testing/Inspecting Agency shall disclose past or current business relationship or potential conflict of interest with Contractor or Subcontractors whose work will be inspected or tested.

1.6 PAYMENT:

- A. Owner will engage and pay for services of Special Inspector and Testing/Inspecting Agency.
- B. If materials requiring Special Inspections are fabricated in a plant not within 200 miles of project site, Contractor shall be responsible for travel expenses of Special Inspector or Testing/Inspecting Agency.
- C. Contractor shall be responsible for cost of retesting or reinspection of work failing to comply with requirements of Contract Documents.

1.7 OWNER RESPONSIBILITIES:

- A. Owner will provide Special Inspector with complete set of Contract Documents sealed by the Registered Design Professional and approved by the Code Enforcement Official.

1.8 CONTRACTOR RESPONSIBILITIES:

- A. Contractor shall cooperate with Special Inspector and his agents so Special Inspections and testing may be performed without hindrance.
- B. As indicated in the Schedule of Special Inspections, Contractor shall notify Special Inspector or Testing/Inspecting Agency at least 48 hours in advance of a required inspection or test.
- C. Contractor shall provide incidental labor and facilities to provide access to work to be inspected or tested, to obtain and handle samples at site or at source of products to be tested, to facilitate tests and inspections, and for storing and curing of test samples.
- D. If Special Inspections or testing require the use of Contractor's scaffolding to access work areas, Contractor shall provide competent person to perform daily evaluation of scaffolding to verify it is safe to use. Contractor shall notify Special Inspector and Testing Agent of this review before each use. Contractor is responsible for safe assembly and stability of scaffolding.
- E. Contractor shall keep latest set of Construction Drawings, field sketches, accepted shop drawings, and specifications at project site for field use by Inspectors and Testing Technicians.
- F. Contractor shall perform remedial work if required and sign nonconformance reports stating remedial work has been completed. Contractor shall submit signed reports to Special Inspector as work proceeds.
- G. The Special Inspection program shall not relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents or from implementing an effective Quality Control program.
- H. Contractor shall be solely responsible for construction site safety.

1.9 LIMITS ON AUTHORITY:

- A. Special Inspector or Testing/Inspecting Agency shall not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Special Inspector or Testing/Inspecting Agency shall not have control over Contractor's means and methods of construction.
- C. Special Inspector or Testing/Inspecting Agency shall not be responsible for construction site safety.
- D. Special Inspector or Testing/Inspecting Agency shall not have authority to stop work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK:

- A. General: Special Inspector shall perform inspections and verifications or coordinate the RDP for Geotechnical Engineering to perform inspections and verifications including the following:
 1. Identify soils requiring undercutting and replacing while observing proof rolling and when subgrade is exposed.

2. Verify footing bearing strata.
 3. Review and accept materials proposed by Contractor for use as compacted fill based on test data and information submitted by Testing Agency. Material approval shall be based on requirements and recommendations stated in Project Geotechnical and Subsurface Investigation.
 4. Observe and accept filling and compaction procedures.
 5. Observe and accept preparation of slab-on-grade subgrade and crushed stone subbase.
- B. Testing Compaction:
1. Testing Agency shall perform moisture content testing for each type of fill, backfill, and subgrade material used, in compliance with ASTM D1557.
 2. Testing Agency shall perform field density tests for building subgrades, tunnel subgrades and for fill materials in accordance with ASTM D 1557 or ASTM D 2922 as follows:
 - a. Building and tunnel subgrade for each lift of compacted material.
 - b. Foundation Wall Backfill.
 - c. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
 - d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
 - e. Trenches: One test at maximum 30 m (100 foot) intervals per 120mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
 - f. Footing subgrade and each stratum of soil on which footings will be placed.
 3. Inspect each subgrade and fill layer before further backfill or construction work is performed. Approval shall be based on satisfactory achievement of compaction criteria.
 4. Verify use of fill material and lift thicknesses in field.

3.2 LANDSCAPING:

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

3.3 ASPHALT CONCRETE PAVING:

- A. Aggregate Base Course:
 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with // AASHTO T180, Method D // ASTM D1557, Method D //
 2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556.

3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.

B. Asphalt Concrete:

1. Aggregate: Sample and test aggregates in stock pile and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104).
2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.
3. Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

3.4 SITE WORK CONCRETE:

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

3.5 CONCRETE AND REINFORCEMENT:

A. Special Inspector shall perform the following:

1. Inspect reinforcing steel and placement.
2. Inspect embedded bolts and anchor rods prior to concrete placement.

B. Testing Agency shall perform the following:

1. Verify use of required design mix.
2. Sample and test concrete during placement as follows. Test shall be taken at point of discharge into structure:
 - a. Record specific locations where concrete was placed. Refer to column lines where possible.
 - b. Record time concrete is batched as shown in truck ticket, time placement begins/sample time, and time truck is emptied.
 - c. Sample fresh concrete in accordance with ASTM C 172, except modified for slump to comply with ASTM C 94.
 - d. Perform slump test in accordance with ASTM C 143.
 - e. Measure air content in accordance with ASTM C 231, pressure method, one for each truckload of ready-mixed concrete, air-entrained or non-air-entrained.
 - f. Record temperature of concrete for each truck. Test in-place concrete temperature hourly when ambient temperature is 40 degrees F and below and when 80 degrees F and above.
 - g. Record air temperature and general weather conditions (cloudy, windy, sunny, etc.).
 - h. Record unit weight of fresh normal-weight concrete in accordance with ASTM C 138.
 - i. Perform concrete compressive tests as follows:
 - 1) Prepare compressive test specimens in accordance with ASTM C 31. Store undisturbed in insulated box during cold weather.

Deliver to laboratory between 16 and 32 hours after making. Perform compressive tests in accordance with ASTM C 39: two specimens tested at 7 days, two specimens tested at 28 days, and two specimens retained for later testing if required.

- 2) In cold weather or whenever steel erection is scheduled to commence less than 14 days after placement of supporting foundation concrete, cast additional set of four cylinders for each 50 cubic yard or fraction thereof of supporting foundation concrete. Field-cure cylinders, and test two specimens at 7 days, retaining two specimens for later testing if required. Steel erection may not begin until supporting concrete obtains 75 percent of its design strength.
 - 3) If concrete will be placed in separate buildings on a given project, make individual compressive strength test cylinders for each building.
- j. Perform additional testing as follows if required:
- 1) Take additional set of cylinders for compressive strength testing for each truck in which total time period between batching and completing placement has exceeded ACI-recommended, 90-minute-maximum time limit and is likely to exceed 120 minutes. Take additional cylinders within 10 minutes of placement completion.
 - 2) Make additional tests of in-place concrete when test results indicate specified concrete strengths or other characteristics have not been attained in structure.
 - 3) Perform tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods acceptable to Architect.
 - 4) Contractor shall reimburse Owner for cost of additional tests.
3. Inspect concrete placement for proper application techniques.
 4. Inspect for maintenance of specified curing temperature and techniques.

3.6 STRUCTURAL STEEL:

- A. Special Inspector shall perform the following:
1. Verify Fabricator maintains detailed fabrication and Quality Control procedures:
 - a. Review procedures for completeness and adequacy relative to code requirements.
 - b. If Fabricator is designated as AISC-Certified Fabricator, Special Inspection for shop-fabricated members and assemblies is not required.
 - c. If Fabricator is not designated as AISC-Certified Fabricator, Contractor shall reimburse Owner via execution of credit change order for cost of Special Inspections and testing in Fabricator's shop.

2. Review manufacturer's Certificates of Compliance for high-strength bolts and weld filler material.
3. Review certified mill test reports.
4. Inspect steel frame joint details for compliance with approved Construction Documents.

B. Testing Agency shall perform the following:

1. Material verification of high-strength bolts, nuts, and washers, including review of identification markings and manufacturer's Certificate of Compliance.
 - a. Test high-strength bolt assemblies in a tension measuring device to verify material conformance prior to installation. Assemble bolt, nut, and washer on a loose plate and tension by tightening nut to develop required tension in Table 4 of "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
2. Verification that copies of accepted field welding procedure specifications are available on-site for reference by erector's welders.
3. Verification that erector's welder's qualifications are current and appropriate for joint type, welding position, and welding process to be used.
4. Verification that joint fitup for partial and complete penetration groove welds are in compliance with AWS tolerances as follows:
 - a. Visually inspect 50 percent of joints scheduled for partial and complete penetration groove welds.
5. Inspect high-strength bolting.
 - a. Joints designated as snug tight require only visual inspection.
6. Material verification of structural steel and metal deck, including review of identification markings.
7. Perform pull-out tests on adhesive, expansion, and sleeve anchors.
8. Material verification of weld filler materials, including review of identification markings.
9. Inspect welding of structural.
 - a. Visually inspect welds according to AWS.
 - b. Schedule inspection of field welding in timely manner utilizing vertical access means and methods utilized by Contractor to perform the welding.
 - c. Magnetic particle inspection according to ASTM E 709 is required for Fabricators not certified by AISC Quality Certification Program for 10 percent of shop fillet welds.
 - d. Magnetic particle inspection according to ASTM E 709 is required for 10 percent of field fillet welds.
 - e. UT inspect according to ASTM E 587 is required for 10 percent of shop partial or complete penetration welds and 100 percent of shop partial or complete penetration groove welds in tension members.
10. Inspect condition of erected materials.

- a. Visually inspect erected steel for damage.
 - b. Visually inspect connections and framing to verify compliance with Contract Documents and accepted shop drawings.
11. Inspect column plumbness and splices:
- a. Inspect erected columns for plumbness within tolerances specified in Section 05 12 00, Part 3: Execution.
 - b. Inspect columns for fit up within tolerances specified in AISC *Manual of Steel Construction*, Specification Section M4.
12. Additional testing shall be performed as follows if required.
- a. Testing Agency shall perform additional tests of connections and framing members field modified by Contractor to correct errors in shop drawings, fabrication, or erection.
 - b. Anchor rods and embedded structural supports incorrectly located or damaged after installation shall be field modified by Contractor as indicated in Section 03300 and tested by Testing Agency.
 - c. Testing and reporting of field modifications shall be in accordance with this section, Special Inspections, and have the following additional requirements:
 - 1) Magnetic particle inspection according to ASTM E 709 is required for 100 percent of fillet welds.
 - 2) Perform pull-out tests on 100 percent of each type of adhesive, expansion, or sleeve anchor used by applying a load equal to 125 percent of allowable pull-out strength listed in manufacturer's literature.
 - d. Contractor shall reimburse Owner for cost of additional tests performed.

PART 4 - DOCUMENTATION

4.1 RECORDS AND REPORTS:

- A. Prepare detailed reports of each test or inspection. Include the following general information:
 - 1. Project name and number.
 - 2. Date of test or inspection.
 - 3. Name of Testing Agency or Inspecting Agency.
 - 4. Name of technician or inspector.
 - 5. Weather conditions.
 - 6. Locations and elevations of specific areas tested or inspected referenced to grid lines.
 - 7. Description of test or inspection.
 - 8. Reference to applicable ASTM standard.
 - 9. Summary of observations, results, and recommendations.
 - 10. Description of areas or materials requiring retesting or reinspection.

- B. Concrete compressive strength test reports shall contain the following information:
 1. Name of Contractor and concrete supplier.
 2. Name of concrete testing service.
 3. Name of technician making and testing specimens.
 4. Truck number and delivery ticket number.
 5. Date and location within structure of concrete placement.
 6. Concrete type, class, mix proportions of materials, and design compressive strength at 28 days.
 7. Slump, air content, unit weight, and concrete temperature.
 8. Total time period between batching and completing placement for each truck.
 9. Compressive strength and type of break for tests.
- C. Field reports for concrete inspection shall contain general information noted above plus ambient temperature and cylinder numbers.
- D. Test reports for masonry materials shall include proportions, composition, and compressive strength.

4.2 COMMUNICATION:

- A. Testing/Inspecting Agency shall immediately notify Contractor, Special Inspector, and Registered Design Professional by telephone, fax, or e-mail of test results failing to comply with requirements of Contract Documents.
- B. Special Inspector shall immediately notify Contractor of work found to be in nonconformance with Contract Documents during inspections. If nonconforming work is not corrected while Special Inspector is on-site, Special Inspector shall notify Registered Design Professional within 24 hours (one business day) and issue a nonconformance report. Special Inspector may use Special Inspection Non-Conformance Report form at end of this section or other similar form.
- C. If nonconforming work is not corrected at time of substantial completion of structure or other appropriate time, Special Inspector shall notify Code Enforcement Official.

4.3 DISTRIBUTION OF REPORTS:

- A. Testing/Inspecting Agency shall submit reports to Special Inspector and Registered Design Professional within 7 days of inspection or test. Legible handwritten reports may be submitted if final typed copies are not available.
- B. Special Inspector shall submit reports to Registered Design Professional within 7 days of inspections. Legible handwritten reports may be submitted if final typed copies are not available.
- C. If requested by the Code Enforcement Official, Special Inspector shall submit interim reports that include inspections and tests performed since beginning of construction or since previous interim report. Interim reports shall be addressed to the Code Enforcement Official with copies sent to the Registered Design Professionals (Structural Engineer and Architect) and Contractor. Interim reports shall be signed by Agent performing inspections.

4.4 FINAL REPORT OF SPECIAL INSPECTIONS:

- A. At completion of work, each Testing/Inspecting Agency shall submit Agent's Final Report of Special Inspections to Special Inspector stating work was completed in substantial conformance with Contract Documents and appropriate inspections and tests were performed. Testing/Inspecting Agency may use Agent's Final Report of Special Inspections form provided at end of this section or other similar form.
- B. At completion of work, Special Inspector shall compile inspection and test reports generated by each Agent into a Final Report of Special Inspections. Final Report of Special Inspections shall state required inspections have been performed and itemize nonconforming work not corrected or resolved.
- C. Special Inspector may use Final Report of Special Inspections form provided at end of this section or other similar form based on CASE Form 102-2001.
- D. Special Inspector shall submit Final Report of Special Inspections to Registered Design Professional and Code Enforcement Official prior to issuance of a Certificate of Use and Occupancy.

SPECIAL INSPECTION NON-CONFORMANCE REPORT NO.

DATE: _____

TO: Neil Weisel, P.E. Registered Design Professional (RDP)
Ryan-Biggs Associates, P.C., 257 Ushers Road, Clifton Park, NY
12065
E-mail: nweisel@ryanbiggs.com
Fax: (518) 406-5514

CC: Contractor: _____

FROM: _____, Special Inspector

PROJECT: **Repair Hot Water Lines - Phase III**
Stratton VA Medical Center
Ryan-Biggs Project 10046-3

PART I: REFERENCE SPECIAL INSPECTION REPORT NO. (Attach copy of report.)

DESCRIPTION OF NON-CONFORMANCE:

RDP REPONSE: (PROVIDE ATTACHMENTS IF NECESSARY)

RDP SIGNATURE _____ DATE _____

IS REINSPECTION BY SPECIAL INSPECTOR REQUIRED YES NO

PART II: CONTRACTOR VERIFICATION (To be completed by either the Construction Manager or Subcontractor and returned to the Special Inspector and RDP.)

I verify that as of the date listed, the non-conforming item noted above has been corrected as required.

Date Completed _____ By _____
(Contractor's Site Representative)

Agent's Final Report of Special Inspections

Project Name: Repair Hot Water Lines - Special Inspector: _____
Phase II _____
Stratton VA Medical Center _____
Location: Albany, NY Agent: _____
Ryan-Biggs Project: 10046 _____
Agent's Project: _____

To the best of my information, knowledge, and belief, the Special Inspections and testing required for this project and designated for this Agent in the Statement of Special Inspections (which includes Specification Section 01 45 29 and the Schedule of Special Inspections) have been performed and discovered discrepancies have been reported and resolved except for the following:

Comments:

[Attach continuation sheets if required to complete description of uncorrected discrepancies.]

Respectfully submitted,

Agent of the Special Inspector

(Type or print name)

Signature Date

Address

City, State, Zip



Final Report of Special Inspections
and Structural Observations

Project Name: Repair Hot Water Lines - Phase II Stratton VA Medical Center	Registered Design Professionals: _____ _____
Location: Albany, NY	Architecture:
Ryan-Biggs Project: 9856-1	Structural Engineering:
Owner:	Ryan-Biggs Associates, P.C.
Owner's Address:	257 Ushers Road Clifton Park, NY 12065

Special Inspector: _____

To the best of my information, knowledge, and belief, Special Inspections and Structural Observations required for this project, as indicated in the Statement of Special Inspections, (which includes Specification Section 01 45 29 and the Schedule of Special Inspections) have been performed and discovered discrepancies have been reported and resolved except for the following:

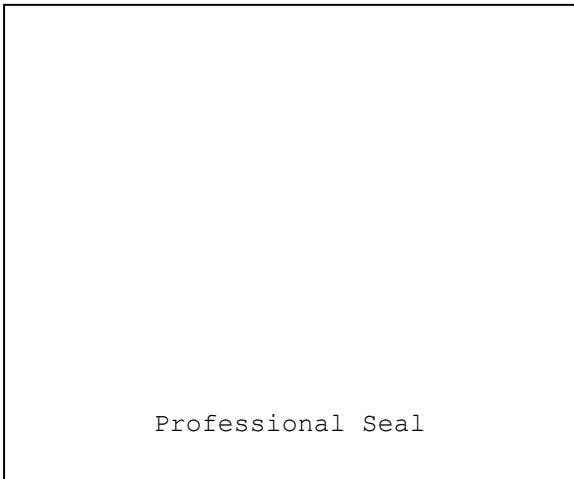
Comments:

[Attach continuation sheets if required to complete description of uncorrected discrepancies.]

Interim reports form a basis for and are to be considered an integral part of this final report. Agent's Final Reports of Special Inspections are attached and are also a part of this final report.

(Type or print name)

Signature Date



- - - END - - -

SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

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

7. Sanitary Wastes:

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

1.2 QUALITY CONTROL

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

1.3 REFERENCES

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

1.4 SUBMITTALS

- A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
 - 1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Resident Engineer to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the Resident Engineer and 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, 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. Dewatering basin, dewatering excavation, trenches, etc. through dewatering basin or other approved device only. Do not dewater directly into storm systems.
 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, the other sediment / erosion control plan. Maintain temporary erosion and sediment control measures until permanent drainage and erosion control facilities are completed and operative.
 6. Protect adjacent areas from despoilment by temporary excavations and embankments.
 7. 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.
8. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 9. Handle discarded materials other than those included in the solid waste category as directed by the Resident Engineer.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
 2. Monitor water areas affected by construction.
- D. Protection of 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 New York Department of Environmental Conservation 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.
- E. 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 the hours agreed upon with 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		
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.
- F. 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.
- G. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the Resident Engineer. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Section 02 41 00, DEMOLITION.
- B. Section 01 00 00, GENERAL REQUIREMENTS.

1.3 QUALITY ASSURANCE

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

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

1.4 TERMINOLOGY

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

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

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:
- B. Prepare and submit to the COR a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
 - 1. Procedures to be used for debris management.
 - 2. Techniques to be used to minimize waste generation.
 - 3. Analysis of the estimated job site waste to be generated:

- a. List of each material and quantity to be salvaged, reused, recycled.
 - b. List of each material and quantity proposed to be taken to a landfill.
4. Detailed description of the Means/Methods to be used for material handling.
- a. On site: Material separation, storage, protection where applicable.
 - b. Off site: Transportation means and destination. Include list of materials.
 - 1) Description of materials to be site-separated and self-hauled to designated facilities.
 - 2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
 - c. The names and locations of mixed debris reuse and recycling facilities or sites.
 - d. The names and locations of trash disposal landfill facilities or sites.
 - e. Documentation that the facilities or sites are approved to receive the materials.
- C. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
- D. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

1.6 APPLICABLE PUBLICATIONS

- A Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.
- B. U.S. Green Building Council (USGBC):
LEED Green Building Rating System for New Construction

1.7 RECORDS

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

PART 2 - PRODUCTS**2.1 MATERIALS**

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

PART 3 - EXECUTION**3.1 COLLECTION**

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

3.2 DISPOSAL

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

3.3 REPORT

- A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.
- B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.
- C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

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SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 RELATED WORK:

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING.
- B. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Asbestos Removal: Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
- F. Lead Paint: Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
- G. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- H. Construction Waste Management: Section 017419 CONSTRUCTION WASTE MANAGEMENT.
- I. 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. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
 - 1. No wall or part of wall shall be permitted to fall outwardly from structures.
 - 2. Maintain at least one stairway in each structure in usable condition to highest remaining floor. Keep stairway free of obstructions and debris until that level of structure has been removed.
 - 3. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
 - 4. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- G. 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.
- H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- I. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.

1.4 UTILITY SERVICES:

- A. Demolish and remove outside utility service lines shown to be removed.

- B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DEMOLITION:

- A. Completely demolish and remove buildings and structures, including all appurtenances related or connected thereto, as noted below:
 - 1. As required for installation of new utility service lines.
 - 2. To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new structures.
- B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Medical Center to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Resident Engineer. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- C. In removing buildings and structures of more than two stories, demolish work story by story starting at highest level and progressing down to third floor level. Demolition of first and second stories may proceed simultaneously.
- D. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500mm (5feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.
- E. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Resident Engineer. When Utility lines are encountered that are not indicated on the drawings, the Resident Engineer shall be notified prior to further work in that area.

3.2 CLEAN-UP:

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to Resident Engineer.

Clean-up shall include off the Medical Center disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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SECTION 02 82 11
TRADITIONAL ASBESTOS ABATEMENT

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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 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 Asbestos Abatement Contractor. All costs incurred due to such action are also the responsibility of the Asbestos Abatement Contractor.

1.1.2 EXTENT OF WORK

- A. Below is a brief description of the estimated quantities of asbestos containing materials to be abated. These quantities are for informational purposes only and are based on the best information available at the time of the specification preparation. The Contractor shall satisfy himself as the actual quantities to be abated. Nothing in this section may be interpreted as limiting the extent of work otherwise required by this contract and related documents.
- B. Removal, clean-up and disposal of asbestos containing materials (ACM) and asbestos/waste contaminated elements in an appropriate regulated area for the following approximate quantities;
 - 12 feet of >4" diameter pipe insulation

1.1.3 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING.
- B. Section 02 41 00, DEMOLITION.
- C. Division 09, FINISHES
- D. Division 22, PLUMBING.
- E. Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION / Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING / Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- F. Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION / Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING / Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION
- G. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- H. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING / Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING / Section 22 05 33, HEAT TRACING FOR PLUMBING PIPING / Section 22 11 00, FACILITY WATER DISTRIBUTION / Section 22 13 00, FACILITY SANITARY SEWERAGE / Section 22 13 23, SANITARY WASTE INTERCEPTORS / Section 22 14 00, FACILITY STORM DRAINAGE / Section 22 66 00, CHEMICAL-WASTE SYSTEMS FOR

LABORATORY AND HEALTHCARE FACILITIES / Section 23 11 23, FACILITY NATURAL-GAS PIPING.

- I. Section 23 21 13, HYDRONIC PIPING / Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING.
- J. Section 23 31 00, HVAC DUCTS AND CASINGS / Section 23 37 00, AIR OUTLETS AND INLETS.

1.1.4 TASKS

The work tasks are summarized briefly as follows:

- A. Pre-abatement activities including pre-abatement meeting(s), inspection(s), notifications, permits, submittal approvals, regulated area preparations, emergency procedures arrangements, and standard operating procedures for asbestos abatement work.
- B. Abatement activities including removal, encapsulation, enclosure, 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.

1.1.5 CONTRACTORS 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 VA Design and Construction Procedures. VA Design and Construction Procedures 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 estimated which are limited by the physical constraints imposed by occupancy of the buildings and accessibility to ACM. 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 newly discovered ACM and those prices shall be used for additional work required under the contractor.

1.3 STOP ASBESTOS REMOVAL

If the Contracting Officer; their field representative; (the facility Safety Officer/Manager or their designee, or the VA Professional Industrial Hygienist/Certified Industrial Hygienist (VPIH/CIH) presents

a verbal **Stop Asbestos Removal Order**, the Contractor/Personnel shall immediately stop all asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM. If a verbal Stop Asbestos Removal Order is issued, the VA shall follow-up with a written order to the Contractor as soon as it is practicable. The Contractor shall not resume any asbestos removal activity until authorized to do so in writing by the VA Contracting Officer. A stop asbestos removal order may be issued at any time the VA Contracting Officer determines abatement conditions/activities are not within VA specification, regulatory requirements or that an imminent hazard exists to human health or the environment. 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 VPIH/CIH time. The occurrence of any of the following events shall be reported immediately by the Contractor's competent person to the VA Contracting Office or field representative using the most expeditious means (e.g., verbal or telephonic), followed up with written notification to the Contracting Officer as soon as practical. The Contractor shall immediately stop asbestos removal/disturbance activities and initiate fiber reduction activities:

- A. Airborne PCM analysis results equal to or greater than 0.01 f/cc outside a regulated area or >0.05 f/cc inside a regulated area;
- B. breach or break in regulated area containment barrier(s);
- C. less than -0.02" WCG pressure in the regulated area;
- D. serious injury/death at the site;
- E. fire/safety emergency at the site;
- F. respiratory protection system failure;
- G. power failure or loss of wetting agent; or
- H. 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. Includes removal, encapsulation, enclosure, demolition, and renovation activities related to asbestos containing materials (ACM).

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. For personal samples and clearance air testing using Phase Contrast Microscopy (PCM) analysis. NIOSH Method 7402 can be used when it is necessary to confirm fibers counted by PCM as being asbestos. The AHERA TEM analysis may be used for background, area samples and clearance samples when required by this specification, or at the discretion of the VPIH/CIH as appropriate.

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 Hazard Abatement Plan (AHAP) - Asbestos work procedures required to be submitted by the contractor before work begins.

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

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

Asbestos-contaminated soil (ACS) - Soil found in the work area or in adjacent areas such as crawlspaces or pipe tunnels which is contaminated with asbestos-containing material debris and cannot be easily separated from the material.

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

Asbestos Project Monitor - Some states require that any person conducting asbestos abatement clearance inspections and clearance air sampling be licensed as an asbestos project monitor.

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 representative having jurisdiction over the regulated area (e.g., OSHA, Federal and State EPA).

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 - Plastic barriers placed over critical barriers and exposed directly to abatement work.

Secondary Barrier - Any additional plastic barriers 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) - A person certified in the comprehensive practice of industrial hygiene 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 professional industrial hygiene consultant/Certified Industrial Hygienist (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/CIH) - The asbestos abatement contractor's industrial hygienist. The industrial hygienist must meet the qualification requirements of a PIH and may be a certified industrial hygienist (CIH).

Count - Refers to the fiber count or the average number of fibers greater than five microns in length with a length-to-width (aspect) ratio of at least 3 to 1, per cubic centimeter of air.

Crawlspace - An area which can be found either in or adjacent to the work area. This area has limited access and egress and may contain asbestos materials and/or asbestos contaminated soil.

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.

VA Total - means a building or substantial part of the building is completely removed, torn or knocked down, bulldozed, flattened, or razed, including removal of building debris.

Disposal bag - Typically 6 mil thick sift-proof, dustproof, leak-tight 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 sift-proof, dustproof, and leak-tight.

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 (aspect) 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 one (1) percent or 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 - An ASHRAE MERV 17 filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers 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 (IH) - 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 (IH 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. Some states require that an industrial hygienist technician conducting asbestos abatement clearance inspection and clearance air sampling be licensed as an asbestos project monitor.

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) - EPA's rule to control emissions of asbestos to the environment (40 CFR part 61, Subpart M).

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.

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 column 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 pressure outside the respirator facepiece.

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 to remove organic vapor hazardous air contaminants.

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 for one or workers within the regulated area using a filter cassette and a calibrated air sampling 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 eight (8) hour time weighted average PEL is 0.1 fibers per cubic centimeter (0.1 f/cc) of air and the 30-minute Excursion Limit is 1.0 fibers per cubic centimeter (1 f/cc).

Personal protective equipment (PPE) - equipment designed to protect user from injury and/or specific job hazard. Such equipment may include protective clothing, hard hats, safety glasses, and respirators.

Pipe tunnel - An area, typically located adjacent to mechanical spaces or boiler rooms in which the pipes servicing the heating system in the building are routed to allow the pipes to access heating elements. These areas may contain asbestos pipe insulation, asbestos fittings, or asbestos-contaminated soil.

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, flame retardant per NFPA 241.

Positive/negative fit check - A method of verifying the seal of a facepiece respirator by temporarily occluding the filters and breathing in (inhaling) and then temporarily occluding the exhalation valve and breathing out (exhaling) while checking for inward or outward leakage of the respirator respectively.

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 (b).

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. The PIH may be either the VA's PIH (VPIH) or Contractor's PIH (CPIH/CIH).

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).

Assigned protection factor - A value assigned by OSHA/NIOSH to indicate the expected protection provided by each respirator class, when the respirator is properly selected and worn correctly. The number indicates the reduction of exposure level from outside to inside the respirator facepiece.

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 non-friable ACM that has become friable; Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading or; Category II non-friable 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.

Supplied air respirator (SAR) - A respiratory protection system that supplies minimum Grade D respirable air per ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989.

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 Professional Industrial Hygienist (VPIH/CIH) - The Department of Veterans Affairs Professional Industrial Hygienist must meet the qualifications of a PIH, and may be a Certified Industrial Hygienist (CIH).

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/ACS or ACM waste material.

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

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

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. NIST National Institute for Standards and Technology
U. S. Department of Commerce
Gaithersburg, MD 20234
301-921-1000
- K. NEC National Electrical Code (by NFPA)
- L. NEMA National Electrical Manufacturer's Association
2101 L Street, N.W.
Washington, DC 20037
- M. NFPA National Fire Protection Association
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
800-344-3555
- N. NIOSH National Institutes for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, OH 45226
513-533-8236
- O. OSHA Occupational Safety and Health Administration
U.S. Department of Labor

Government Printing Office
Washington, DC 20402

P. UL Underwriters Laboratory
333 Pfingsten Rd.
Northbrook, IL 60062
312-272-8800

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 specifications 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 ASBESTOS ABATEMENT CONTRACTOR RESPONSIBILITY

The Asbestos Abatement Contractor (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 asbestos abatement project. The Contractor is responsible for providing and maintaining training, accreditations, medical exams, medical records, personal protective equipment (PPE) including respiratory protection including respirator fit testing, as required by applicable Federal, State and Local regulations. The Contractor shall hold the VA and VPIH/CIH consultants harmless for any Contractor's 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/CIH, including all sampling/analytical costs to assure compliance with OSHA/EPA/State requirements related to failure to comply with the regulations applicable to the work.

1.5.3 FEDERAL REQUIREMENTS

Federal requirements which govern 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 Subpart I - Personal Protective Equipment
 - 3. Title 29 CFR 1910.134 - Respiratory Protection
 - 4. Title 29 CFR 1926 - Construction Industry Standards
 - 5. Title 29 CFR 1910.1020 - Access to Employee Exposure and Medical Records
 - 6. Title 29 CFR 1910.1200 - Hazard Communication
 - 7. Title 29 CFR 1910 Subpart K - 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**)
 1. Title 49 CFR 100 - 185 - Transportation

1.5.4 STATE REQUIREMENTS

State requirements that apply to the asbestos abatement work, disposal, clearance, etc., include, but are not limited to, the following:

- A. Asbestos Bureau Control
 1. Industrial Code Rule 56 (12 NYCRR Part 56)

1.5.6 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 and ANSI 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

1.5.7 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

1.5.8 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 are given to EPA, State, and Local authorities.

1.5.9 PERMITS/LICENSES

- A. 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.

1.5.10 POSTING AND FILING OF REGULATIONS

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

1.5.11 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, calibration data and method of analysis. 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.

1.5.12 EMERGENCY ACTION PLAN AND ARRANGEMENTS

- A. An Emergency Action Plan shall be developed 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 in the clean room and equipment room of the decontamination unit. 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; layout of regulated area; and access to the 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 any/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 3-4 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; power failure; negative pressure failure; and supplied air system failure. The Contractor shall detail procedures to be followed in the event of an incident assuring that asbestos abatement work is stopped and wetting is continued until correction of the problem.

1.5.13 PRE-CONSTRUCTION MEETING

Prior to commencing the work, the Contractor shall meet with the VA Certified Industrial Hygienist (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(s) is trained and accredited and approved for working in this State. Verification of the experience of the Competent Person(s) 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 Asbestos Hazard Abatement Plan. 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. Decontamination area set-up/layout and decontamination procedures for employees;
 - 4. 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(s) 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 color 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 federal (and state as applicable) EPA and OSHA asbestos regulations in the past three (3) years; has adequate liability/occurrence insurance for asbestos work as required by the state; 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 within the past three (3) years; 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/CIH (CPIH/CIH) 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 or equivalent, 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 within the past three (3) years of similar size and

complexity; has applicable medical and respiratory protection documentation; has certificate of training/current refresher and State accreditation/license.

All personnel should be in compliance with OSHA construction safety training as applicable and submit certification.

1.7 RESPIRATORY PROTECTION

1.7.1 GENERAL - RESPIRATORY PROTECTION PROGRAM

The Contractor shall develop and implement a written 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.Subpart I;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 RPP 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 RPP of similar size and complexity. The RPPC must submit 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 qualifications. 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 or other licensed health care professional has provided a written determination they are medically qualified to wear the class of respirator to be used on the project while wearing whole body impermeable garments and subjected to heat or cold stress.

1.7.6 RESPIRATOR FIT TEST

All personnel wearing respirators shall have a current qualitative/quantitative fit test which was conducted in accordance

with 29 CFR 1910.134 (f) and Appendix A. Quantitative fit tests shall be done for PAPRs which have been put into a motor/blower failure mode.

1.7.7 RESPIRATOR FIT CHECK

The Competent Person shall assure that the positive/negative pressure user seal check is done each time the respirator is donned by an employee. Head coverings must cover respirator head straps. Any situation that prevents an effective facepiece to face seal as evidenced by failure of a user seal check shall preclude that person from wearing a respirator inside the regulated area 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.

1.7.9 SUPPLIED AIR SYSTEMS

If a supplied air system is used, the system shall meet all requirements of 29 CFR 1910.134 and the ANSI/Compressed Gas Association (CGA) Commodity Specification for Air current requirements for Type 1 - Grade D breathing air. Low pressure systems are not allowed to be used on asbestos abatement projects. Supplied Air respirator use shall be in accordance with EPA/NIOSH publication EPA-560-OPTS-86-001 "A Guide to Respiratory Protection for the Asbestos Abatement Industry". The competent person on site will be responsible for the supplied air system to ensure the safety of the worker.

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. A current physician's written opinion as required by 29 CFR 1926.1101 (m)(4) shall be provided for each person and shall include in the medical opinion the person has been evaluated for working in a heat and cold stress environment while wearing personal protective equipment (PPE) and is able to perform the work without risk of material health impairment.

1.8.3 REGULATED AREA ENTRY PROCEDURE

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.

1.8.4 DECONTAMINATION PROCEDURE

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 inhaling 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.

1.8.5 REGULATED AREA REQUIREMENTS

The Competent Person shall meet all requirements of 29 CFR 1926.1101 (o) and assure that all requirements for 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 decontamination facilities (PDF) and waste/equipment decontamination facilities (W/EDF). Ensure that the PDF are 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 must go through the PDF and shall follow the requirements at 29 CFR 1926.1101 (j)(1) and these specifications. All waste, equipment and contaminated 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. Weight inner doorway 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 and reduce potential for non-authorized personnel entering the regulated area.

1.9.3 TEMPORARY FACILITIES TO THE PDF AND W/EDF

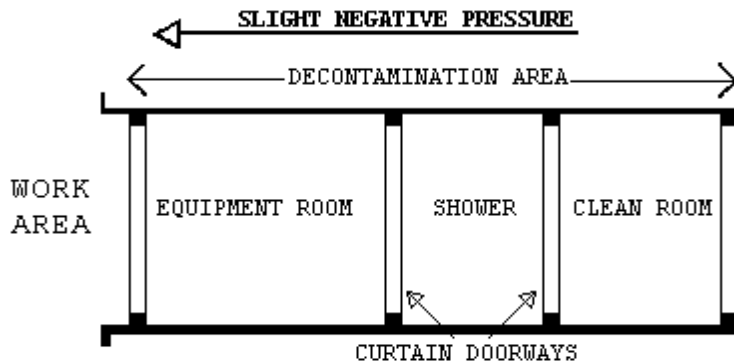
The Competent Person shall provide temporary water service connections to the PDF and W/EDF. Backflow prevention must be provided at the point of connection to the VA system. Water supply must be of adequate pressure and meet requirements of 29 CFR 1910.141(d)(3). Provide adequate temporary overhead electric power with ground fault circuit interruption (GFCI) protection. Provide a sub-panel equipped with GFCI protection 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, if needed, 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 which is connected to the regulated area. 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 insure 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 3 layers of 6 mil opaque fire retardant poly to provide an air tight room. Provide a minimum of 2 - 900 mm (3 foot) wide 6 mil poly opaque fire retardant 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. Provide 1 storage locker per person. A portable fire extinguisher, minimum 10 pounds capacity, 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

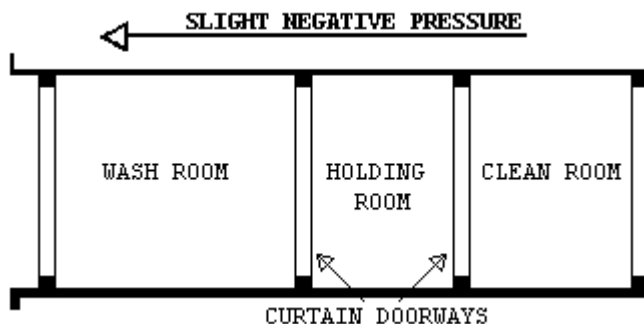
- either from the outside with street clothing on or is coming from the shower room completely naked and thoroughly washed. Females required to enter the regulated area shall be ensured of their privacy throughout the entry/exit process by posting guards at both entry points to the PDF so no male can 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 equipment room 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 opaque 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/tools, reusable personal protective equipment, except for a respirator and for use as a gross decontamination area for personnel exiting the regulated area. The equipment room shall be separated from the regulated area by a minimum 3 foot wide door made with 2 layers of 6 mil opaque 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 opaque 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. If needed, provide a temporary electrical sub-panel equipped with GFCI in the equipment room to accommodate any equipment required in the regulated area.
 4. The PDF shall be as follows: 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 shall be a minimum of 2 layers of 6 mil opaque fire retardant poly.



1.9.5 WASTE/EQUIPMENT DECONTAMINATION FACILITY (W/EDF)

The Competent Person shall provide an W/EDF consisting of a wash room, holding room, and clean room for removal of 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 exterior of the regulated area. 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 2 layers of 6 mil fire retardant poly. When a negative pressure differential system is used, a rigid enclosure separation between the W/EDF clean room and the adjacent areas shall be provided.
5. The W/EDF shall be 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 the 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

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/CIH has submitted verification to the VA's representative.

- 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 and combustible materials cannot be stored inside buildings. Replacement materials shall be stored outside of the regulated 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 location.
- 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. Polyethylene sheeting for walls in the regulated area shall be a minimum of 4-mils. For floors and all other uses, sheeting of at least 6-mil shall be used in widths selected to minimize the frequency of joints. Fire retardant poly shall be used throughout.

- F. 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. Method of attachment may include any combination of moisture resistant duct tape furring strips, spray glue, staples, nails, screws, lumber and plywood for enclosures or other effective procedures capable of sealing polyethylene to dissimilar finished or unfinished surfaces under both wet and dry conditions.
- G. Polyethylene sheeting utilized for the PDF 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, 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. All electrically operated hand tools, equipment, electric cords shall be connected to 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 poly 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 an advance copy of the MSDS as required for all hazardous chemicals under OSHA 29 CFR 1910.1200 - Hazard Communication in the pre-start meeting submittal. Chlorinated compounds shall not be used with any spray adhesive, mastic remover 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 written hazard assessment conducted under 29 CFR 1910.132(d).

2.2 MONITORING, INSPECTION AND TESTING

2.2.1 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. OSHA requires that the employee exposure to asbestos must not exceed 0.1 fiber per cubic centimeter (f/cc) of air, averaged over an 8-hour work shift. The CPIH/CIH is responsible for and shall 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/CIH 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/CIH 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.

2.2.2 SCOPE OF SERVICES OF THE VPIH/CIH CONSULTANT

- A. The purpose of the work of the VPIH/CIH is to: assure quality; adherence to the specification; resolve problems; prevent the spread of contamination beyond the regulated area; and assure clearance at the end of the project. 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. The VPIH/CIH will perform the following tasks:

1. Task 1: Establish background levels before abatement begins by collecting background samples. Retain samples for possible TEM analysis.
 2. Task 2: Perform continuous air monitoring, inspection, and testing outside the regulated area during actual abatement work to detect any faults in the regulated area isolation and any adverse impact on the surroundings from regulated area activities.
 3. Task 3: Perform unannounced visits to spot check overall compliance of work with contract/specifications. These visits may include any inspection, monitoring, and testing inside and outside the regulated area and all aspects of the operation except personnel monitoring.
 4. Task 4: Provide support to the VA representative such as evaluation of submittals from the Contractor, resolution of conflicts, interpret data, etc.
 5. Task 5: Perform, in the presence of the VA representative, final inspection and testing of a decontaminated regulated area at the conclusion of the abatement to certify compliance with all regulations and VA requirements/specifications.
 6. Task 6: Issue certificate of decontamination for each regulated area and project report.
- B. All documentation, 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.

2.2.3 MONITORING, INSPECTION AND TESTING BY CONTRACTOR CPIH/CIH

The Contractor's CPIH/CIH 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/CIH 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 sampling and analysis. The IH Technician shall have successfully completed a NIOSH 582 Course or equivalent and provide documentation. 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 AHERA/State Contractor/Supervisor or Abatement Worker and Building Inspector. The IH Technician shall have participated in five abatement projects collecting personal and area samples as well as responsibility for documentation on substantially similar projects in size and scope. The analytic laboratory used by the Contractor to analyze the samples shall

be AIHA accredited for asbestos PAT and approved by the VA prior to start of the project. A daily log shall be maintained by the CPIH/CIH or IH Technician, documenting all OSHA requirements for air personal 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 upon request. The log will contain, at a minimum, information on personnel or area samples, 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/CIH 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/CIH will perform inspection and testing at the final stages of abatement for each regulated area as specified in the CPIH/CIH responsibilities. Additionally, the CPIH/CIH will monitor and record pressure readings within the containment daily with a minimum of two readings at the beginning and at the end of a shift, and submit the data in the daily report.

2.3 ASBESTOS HAZARD ABATEMENT PLAN

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

- A. Minimum Personnel Qualifications
- B. Emergency Action Plan/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 - Containment Barriers/Isolation of Regulated Area
- G. Decontamination Facilities and Entry/Exit Procedures (PDF and W/EDF)
- H. Negative Pressure Systems Requirements
- I. Monitoring, Inspections, and Testing
- J. Removal Procedures for ACM
- K. Removal of Contaminated Soil (if applicable)
- L. Encapsulation Procedures for ACM
- M. Disposal of ACM waste/equipment
- N. Regulated Area Decontamination/Clean-up
- O. Regulated Area Visual and Air Clearance
- P. Project Completion/Closeout

2.4 SUBMITTALS

2.4.1 PRE-START 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 Asbestos Hazard Abatement Plan developed specifically for this project, incorporating the requirements of the specifications, prepared, signed and dated by the CPIH/CIH.
- D. Submit the specifics of the materials and equipment to be used for this project with manufacturer names, model numbers, performance characteristics, pictures/diagrams, and number available for the following:
 1. Supplied air system, negative air machines, HEPA vacuums, air monitoring pumps, calibration devices, pressure differential monitoring device and emergency power generating system.
 2. Waste water filtration system, shower system, containment barriers.
 3. Encapsulants, surfactants, hand held sprayers, airless sprayers, glovebags, and fire extinguishers.
 4. Respirators, protective clothing, 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. Personal air monitoring must be done in accordance with OSHA 29 CFR 1926.1101(f) and Appendix A. Area or clearance air monitoring shall be conducted in accordance with EPA AHERA protocols.
- 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 (e.g., OSHA), notices of violations (e.g., Federal and state EPA), penalties, and legal actions taken against the company including and of the company's officers (including damages paid) 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; copies of certificates, accreditations, and licenses. Submit an affidavit signed by the CPIH/CIH 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 written respiratory protection program, and maintains recordkeeping in accordance with the above regulations. Submit the phone number and doctor/clinic/hospital used for medical evaluations.
 1. CPIH/CIH and IH Technician: 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 AHAPs developed; medical opinion; and 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 in size/complexity 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 (asbestos surveillance and respirator use); and 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 (asbestos surveillance and respirator use); and 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 language the coverage provided and the fact that asbestos abatement activities are covered by the policy; copy of AHAPs incorporating the requirements of this specification; information on who provides your training, how often; who provides medical surveillance, how often; who performs and how is personal air monitoring of abatement workers conducted; a list of references of independent laboratories/IH's familiar with your air monitoring and standard operating procedures; and copies of monitoring results of the five referenced projects listed and analytical method(s) used.
 - K. Rented equipment must be decontaminated prior to returning to the rental agency.
 - L. Submit, before the start of work, the manufacturer's technical data for all types of encapsulants, all MSDS and application instructions.

2.4.2 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 barrier breeching, equipment failures, emergencies, and any cause for stopping work; and

representative air monitoring and results/TWA's/EL's. Submit this information daily to the VPIH/CIH.

- B. The CPIH/CIH shall document and maintain the inspection and approval of the regulated area preparation prior to start of work and daily during work.
 - 1. Removal of any poly barriers.
 - 2. Visual inspection/testing by the CPIH/CIH or IH Technician prior to application of lockdown encapsulant.
 - 3. Packaging and removal of ACM waste from regulated area.
 - 4. Disposal of ACM waste materials; copies of Waste Shipment Records/landfill receipts to the VA's representative on a weekly basis.

2.4.3 SUBMITTALS AT COMPLETION OF ABATEMENT

The CPIH/CIH 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. It will also include information on the containment and transportation of waste from the containment with applicable Chain of Custody forms. The report shall include a certificate of completion, signed and dated by the CPIH/CIH, in accordance with Attachment #1. All clearance and perimeter area samples must be submitted. The VA Representative will retain the abatement report after completion of the project and provide copies of the abatement report to VAMC Office of Engineer and the Safety Office.

2.5 ENCAPSULANTS

2.5.1 TYPES OF ENCAPSULANTS

- A. The following four types of encapsulants, if used, must comply with 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.

2.5.2 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.

2.5.3 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.

PART 3 - EXECUTION

3.1 REGULATED AREA PREPARATIONS

3.1.1 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 require any unauthorized person to leave the regulated area and then notify the VA Contracting Officer or VA Representative using the most expeditious means.
- 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. 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. In any situation where exposure to high temperatures which may result in a flame hazard, fire retardant poly sheeting must be used.
- 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 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 Representative or Competent Person. The VA Police should be informed of asbestos abatement regulated areas to provide security checks during facility rounds and emergency response.

3.1.2. SIGNAGE AND POWER MANAGEMENT

- A. 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 the PEL. 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.
- B. Shut down and lock out/tag out electric power to the regulated area. Provide temporary power and lighting. Insure safe installation including GFCI of temporary power sources and equipment by compliance with all applicable electrical code and OSHA requirements for temporary electrical systems. Electricity shall be provided by the VA.
- C. Shut down and lock out/tag 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 polyethylene disposal bags for staging and eventual disposal as asbestos waste.

3.1.3 NEGATIVE PRESSURE FILTRATION SYSTEM

The Contractor shall provide enough HEPA negative air machines to effect $> - 0.02''$ WCG pressure. The Competent Person shall determine the number of units needed for the regulated area by dividing the cubic feet in the regulated area by 15 and then dividing that result by the cubic feet per minute (CFM) for each unit to determine the number of units needed to effect $> - 0.02''$ WCG pressure. Provide a standby unit in the event of machine failure and/or emergency in an adjacent area. NIOSH has done extensive studies and has determined that negative air machines typically operate at ~50% efficiency. The contractor shall consider this in their determination of number of units needed to provide $> - 0.02''$ WCG pressure. The contractor shall use double the number of machines, based on their calculations, or submit proof their machines operate at stated capacities, at a 2" pressure drop across the filters.

3.1.3.1 DESIGN AND LAYOUT

- A. Before start of work submit the design and layout of the regulated area and the negative air machines. The submittal shall indicate the number of, location of and size of negative air machines. The point(s) of exhaust, air flow within the regulated area, anticipated negative pressure differential, and supporting calculations for sizing shall be provided. In addition, submit the following:
1. Method of supplying power to the units and designation/location of the panels.
 2. Description of testing method(s) for correct air volume and pressure differential.
 3. If auxiliary power supply is to be provided for the negative air machines, provide a schematic diagram of the power supply and manufacturer's data on the generator and switch.

3.1.3.2 NEGATIVE AIR MACHINES (HEPA UNITS)

- A. Negative Air Machine Cabinet: The cabinet shall be constructed of steel or other durable material capable of withstanding potential damage from rough handling and transportation. The width of the cabinet shall be less than 30" in order to fit in standard doorways. The cabinet must be factory sealed to prevent asbestos fibers from being released during use, transport, or maintenance. Any access to and replacement of filters shall be from the inlet end. The unit must be on casters or wheels.
- B. Negative Air Machine Fan: The rating capacity of the fan must indicate the CFM under actual operating conditions. Manufacturer's typically use "free-air" (no resistance) conditions when rating fans. The fan must be a centrifugal type fan.
- C. Negative Air Machine Final Filter: The final filter shall be a HEPA filter. The filter media must be completely sealed on all edges within a structurally rigid frame. The filter shall align with a continuous flexible gasket material in the negative air machine housing to form an air tight seal. Each HEPA filter shall be certified by the manufacturer to have an efficiency of not less than 99.97%. Testing shall have been done in accordance with Military Standard MIL-STD-282 and Army Instruction Manual 136-300-175A. Each filter must bear a UL586 label to indicate ability to perform under specified conditions. Each filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of test air flow.
- D. Negative Air Machine Pre-filters: The pre-filters, which protect the final HEPA filter by removing larger particles, are required to prolong the operating life of the HEPA filter. Two stages of pre-filtration are required. A first stage pre-filter shall be a low efficiency type for particles 10 μm or larger. A second stage pre-filter shall have a medium efficiency effective for particles down to 5 μm or larger. Pre-filters shall be installed either on or in the intake opening of the NAM and the second stage filter must be held in place with a special housing or clamps.

- E. Negative Air Machine Instrumentation: Each unit must be equipped with a gauge to measure the pressure drop across the filters and to indicate when filters have become loaded and need to be changed. A table indicating the cfm for various pressure readings on the gauge shall be affixed near the gauge for reference or the reading shall indicate at what point the filters shall be changed, noting cfm delivery. The unit must have an elapsed time meter to show total hours of operation.
- F. Negative Air Machine Safety and Warning Devices: An electrical/ mechanical lockout must be provided to prevent the fan from being operated without a HEPA filter. Units must be equipped with an automatic shutdown device to stop the fan in the event of a rupture in the HEPA filter or blockage in the discharge of the fan. Warning lights are required to indicate normal operation; too high a pressure drop across filters; or too low of a pressure drop across filters.
- G. Negative Air Machine Electrical: All electrical components shall be approved by the National Electrical Manufacturer's Association (NEMA) and Underwriters Laboratories (UL). Each unit must be provided with overload protection and the motor, fan, fan housing, and cabinet must be grounded.
- H. It is essential that replacement HEPA filters be tested using an "in-line" testing method, to ensure the seal around the periphery was not damaged during replacement. Damage to the outer HEPA filter seal could allow contaminated air to bypass the HEPA filter and be discharged to an inappropriate location. Contractor will provide written documentation of test results for negative air machine units with HEPA filters changed by the contractor or documentation when changed and tested by the contractor filters

3.1.3.3 PRESSURE DIFFERENTIAL

The fully operational negative air system within the regulated area shall continuously maintain a pressure differential of - 0.02" water column gauge. Before any disturbance of any asbestos material, this shall be demonstrated to the VA by use of a pressure differential meter/manometer as required by OSHA 29 CFR 1926.1101(e)(5)(i). The Competent Person shall be responsible for providing, maintaining, and documenting the negative pressure and air changes as required by OSHA and this specification.

3.1.3.4 MONITORING

The pressure differential shall be continuously monitored and recorded between the regulated area and the area outside the regulated area with a monitoring device that incorporates a strip chart recorder. The strip chart recorder shall become part of the project log and shall indicate at least -0.02" water column gauge for the duration of the project.

3.1.3.5 AUXILIARY GENERATOR

If the building is occupied during abatement, provide an auxiliary gasoline/diesel generator located outside the building in an area protected from the weather. In the event of a power failure of the general power grid and the VAMC emergency power grid, the generator must automatically start

and supply power to a minimum of 50% of the negative air machines in operation.

3.1.3.6 SUPPLEMENTAL MAKE-UP AIR INLETS

Provide, as needed for proper air flow in the regulated area, in a location approved by the VA, openings in the plastic sheeting to allow outside air to flow into the regulated area. Auxiliary makeup air inlets must be located as far from the negative air machines as possible, off the floor near the ceiling, and away from the barriers that separate the regulated area from the occupied clean areas. Cover the inlets with weighted flaps which will seal in the event of failure of the negative pressure system.

3.1.3.7 TESTING THE SYSTEM

The negative pressure system must be tested before any ACM is disturbed in any way. After the regulated area has been completely prepared, the decontamination units set up, and the negative air machines installed, start the units up one at a time. Demonstrate and document the operation and testing of the negative pressure system to the VA using smoke tubes and a negative pressure gauge. Verification and documentation of adequate negative pressure differential across each barrier must be done at the start of each work shift.

3.1.3.8 DEMONSTRATION OF THE NEGATIVE PRESSURE FILTRATION SYSTEM

The demonstration of the operation of the negative pressure system to the VA shall include, but not be limited to, the following:

- A. Plastic barriers and sheeting move lightly in toward the regulated area.
- B. Curtains of the decontamination units move in toward regulated area.
- C. There is a noticeable movement of air through the decontamination units. Use the smoke tube to demonstrate air movement from the clean room to the shower room to the equipment room to the regulated area.
- D. Use smoke tubes to demonstrate air is moving across all areas in which work is to be done. Use a differential pressure gauge to indicate a negative pressure of at least -0.02" across every barrier separating the regulated area from the rest of the building. Modify the system as necessary to meet the above requirements.

3.1.3.9 USE OF THE NEGATIVE PRESSURE FILTRATION SYSTEM DURING ABATEMENT OPERATIONS

- A. Start units before beginning any disturbance of ACM occurs. After work begins, the units shall run continuously, maintaining 4 actual air changes per hour at a negative pressure differential of -0.02" water column gauge, for the duration of the work until a final visual clearance and final air clearance has been successfully completed.

No negative air units shall be shut down at any time unless authorized by the VA Contracting Officer, verbally and in writing.

- B. Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area. After items have been pre-cleaned and decontaminated, they may be removed from the work area for storage until the completion of abatement in the work area.
- C. Abatement work shall begin at a location farthest from the units and proceed towards them. If an electric failure occurs, the Competent Person shall stop all abatement work and immediately begin wetting all exposed asbestos materials for the duration of the power outage. Abatement work shall not resume until power is restored and all units are operating properly again.
- D. The negative air machines shall continue to run after all work is completed and until a final visual clearance and a final air clearance has been successfully completed for that regulated area.

3.1.3.10 DISMANTLING THE SYSTEM

After completion of the final visual and final air clearance has been obtained by the VPIH/CIH, the units may be shut down. The unit exterior surfaces shall have been completely decontaminated; pre-filters are not to be removed and the units inlet/outlet sealed with 2 layers of 6 mil poly immediately after shut down. No filter removal shall occur at the VA site following successful completion of site clearance. OSHA/EPA/DOT asbestos shall be attached to the units.

3.1.4 CONTAINMENT BARRIERS AND COVERINGS IN THE REGULATED AREA

3.1.4.1 GENERAL

Seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent spaces. All surfaces in the regulated area must be covered to prevent contamination and to facilitate clean-up. Should adjacent areas become contaminated as a result of the work, shall immediately stop work and clean up the contamination at no additional cost to the VA. Provide firestopping and identify all fire barrier penetrations due to abatement work as specified in Section 3.1.4.8; FIRESTOPPING.

3.1.4.2 PREPARATION PRIOR TO SEALING THE REGULATED AREA

Place all tools, scaffolding, materials and equipment needed for working in the regulated area prior to erecting any plastic sheeting. All uncontaminated removable furniture, equipment and/or supplies shall be removed by the VA from the regulated area before commencing work. Any objects remaining in the regulated area shall be completely covered with 2 layers of 6-mil fire retardant poly sheeting and secured with duct tape. Lock out and tag out any HVAC/electrical systems in the regulated area.

3.1.4.3 CONTROLLING ACCESS TO THE REGULATED AREA

Access to the regulated area is allowed only through the personnel decontamination facility (PDF). 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 to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid and capable of withstanding the negative pressure.

3.1.4.4 CRITICAL BARRIERS

Completely separate any operations in the regulated area from adjacent areas using 2 layers of 6 mil fire retardant poly 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/openings in the regulated area. Heat must be shut off any objects covered with poly.

3.1.4.5 PRIMARY BARRIERS

- A. Cover the regulated area with two layers of 6 mil fire retardant poly on the floors and two layers of 4 mil, fire retardant poly on the walls, unless otherwise directed in writing by the VA representative. Floor layers must form a right angle with the wall and turn up the wall at least 300 mm (12"). Seams must overlap at least 1800 mm (6') and must be spray glued and taped. Install sheeting so that layers can be removed independently from each other. Carpeting shall be covered with three layers of 6 mil poly. Corrugated cardboard sheets must be placed between the bottom and middle layers of poly. Mechanically support and seal with duct tape and glue all wall layers.

- B. If stairs and ramps are covered with 6 mil plastic, two layers must be used. Provide 19 mm (3/4") exterior grade plywood treads held in place with duct tape/glue on the plastic. Do not cover rungs or rails with any isolation materials.

3.1.4.6 SECONDARY BARRIERS

A loose layer of 6 mil shall be used as a drop cloth to protect the primary layers from debris generated during the abatement. This layer shall be replaced as needed during the work and at a minimum once per work day.

3.1.4.7 EXTENSION OF THE REGULATED AREA

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. Decontamination measures must be started immediately and continue until air monitoring indicates background levels are met.

3.1.4.8 FIRESTOPPING

- A. Through penetrations caused by cables, cable trays, pipes, sleeves, conduits, etc. 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.

3.1.5 SANITARY FACILITIES

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

3.1.6 PERSONAL PROTECTIVE EQUIPMENT

Provide whole body clothing, head coverings, gloves and 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.

3.1.7 PRE-CLEANING

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.

Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area. All workers performing pre-cleaning activities must don appropriate personal protective equipment (PPE), as specified throughout this document and as approved in the Contractor's work plan. After items have been pre-cleaned and decontaminated, they may be

removed from the work area for storage until the completion of abatement in the work area.

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. Drapes, clothing, upholstered furniture and other fabric items should be disposed of as asbestos contaminated waste. Cleaning these asbestos contaminated items utilizing HEPA vacuum techniques and off-premises steam cleaning is very difficult and cannot guarantee decontamination. Carpeting will be disposed of prior to abatement if in the regulated area. If ACM floor tile is attached to the carpet while the Contractor is removing the carpet that section of the carpet will be disposed of as asbestos waste.

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 pre-cleaning, 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.

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.

3.1.8 PRE-ABATEMENT ACTIVITIES

3.1.8.1 PRE-ABATEMENT MEETING

The VA representative, upon receipt, review, and substantial approval of all pre-abatement submittals and verification by the CPIH/CIH 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/CIH, 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.

3.1.8.2 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/CIH 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 AHAP(s), especially worker protection, respiratory systems, contingency plans, decontamination procedures, and monitoring to demonstrate satisfactory operation. The operational systems for respiratory protection and the negative pressure system shall be demonstrated for proper performance.
- C. The CPIH/CIH 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 and all applicable regulations.

3.1.8.3 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 VA A/E Quality Alert 07/09 indicating the failure to identify asbestos in the areas listed as well as common issues when preparing specifications and contract documents. This is especially critical when demolition is planned, because AHERA surveys are non-destructive, and ACM may remain undetected. A NESHAPS (destructive) ACM inspection should be conducted on all building structures that will be demolished. Ensure the following areas are inspected on the project: lay-in ceilings concealing ACM; ACM behind walls/windows from previous renovations; inside utility chases/walls; transite piping/ductwork/sheets; behind radiators; lab fume hoods; transite lab countertops; roofing materials; below window sills; water/sewer lines; electrical conduit coverings; crawlspaces (previous abatement contamination); flooring/mastic covered by carpeting/new flooring; exterior insulated wall panels; on underground fuel tanks; and steam line trench coverings.
- C. Ensure that all furniture, machinery, equipment, curtains, drapes, blinds, and other movable objects required to be

removed from the regulated area have been cleaned and removed or properly protected from contamination.

- D. If present and required, remove and dispose of carpeting from floors in the regulated area.
- E. Inspect existing firestopping in the regulated area. Correct as needed.

3.2 REMOVAL OF ACM

3.2.1 WETTING ACM

- 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 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: When authorized by VA, 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 removal.

3.2.2 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 cover floors and any walls within 10 feet (3 meters) of the area where work is to be done. Secure the secondary barrier with duct tape to prevent it from moving or 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 black poly between the regulated area and the decontamination facilities (PDF and W/EDF) to protect the primary layers from contamination and damage. Install the walkways at the beginning of each shift and remove at the end of each shift.

3.2.3 WET REMOVAL OF ACM

- A. Adequately and thoroughly wet the ACM to be removed prior to removal with amended water or when authorized by VA, removal encapsulant to reduce/prevent fiber release to the air. Adequate time (at a minimum two hours) must be allowed for the amended water or removal encapsulant 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 when authorized in writing by the VPIH/CIH and VA when a greater safety hazard (e.g., electricity) is present.**

- B. If ACM does not wet well with amended water due to composition, coating or jacketing, remove as follows:
1. Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels.
 2. Remove saturated ACM in small sections. Do not allow material to dry out. As material is removed, bag material, while still wet into disposal bags. Twist the bag neck tightly, bend over (gooseneck) and seal with a minimum of three tight wraps of duct tape. Clean /decontaminate the outside of the bag of any residue and move to washdown station adjacent to W/EDF.
 3. Fireproofing or Architectural Finish on Scratch Coat: Spray with a fine mist of amended water or removal encapsulant. Allow time for saturation to the substrate. Do not over saturate causing excess dripping. Scrape material from substrate. Remove material in manageable quantities and control falling to staging or floor. If the falling distance is over 20 feet (6M), use a drop chute to contain material through descent. Remove residue remaining on the scratch coat after scraping is done using a stiff bristle hand brush. If a removal encapsulant is used, remove residue completely before the encapsulant dries. Periodically re-wet the substrate with amended water as needed to prevent drying of the material before the residue is removed from the substrate.
 4. Fireproofing or Architectural Finish on Wire Lath: Spray with a fine mist of amended water or removal encapsulant. Allow time to completely saturate the material. Do not over saturate causing excess dripping. If the surface has been painted or otherwise coated, cut small holes as needed and apply amended water or removal encapsulant from above. Cut saturated wire lath into 2' x 6' (50mm x 150mm) sections and cut hanger wires. Roll up complete with ACM, cover in burlap and hand place in disposal bag. Do not drop to floor. After removal of lath/ACM, remove any overspray on decking and structure using stiff bristle nylon brushes. Depending on hardness of overspray, scrapers may be needed for removal.
 5. Pipe/Tank/Vessel/Boiler Insulation: Remove the outer layer of wrap while spraying with amended water in order to saturate the ACM. Spray ACM with a fine mist of amended water or removal encapsulant. Allow time to saturate the material to the substrate. Cut bands holding pre-formed pipe insulation sections. Slit jacketing at the seams, remove and hand place in a disposal bag. Do not allow dropping to the floor. Remove molded fitting insulation/mud in large pieces and hand place in a disposal bag. Remove any residue on pipe or fitting with a stiff bristle nylon brush. In locations where pipe fitting insulation is removed from fibrous glass or other non-asbestos insulated straight runs of pipe, remove fibrous material at least 6" from the point it contacts the ACM.

3.2.4 REMOVAL OF ACM/DIRT FLOORS AND OTHER SPECIAL PROCEDURES

A. MAJOR ABATEMENT ON DIRT FLOORS:

When working on dirt floors, remove all visible asbestos debris using wet methods after set-up of PDF, W/EDF, negative air systems as required. Perform work and decontaminate/clean-up; perform lockdown as needed and complete work as required in these specifications. The asbestos contaminated soil (ACS) shall be removed and/or enclosed.

Options for abatement of asbestos contaminated soil include: Removal of top 6 inches of soil; encapsulated the soil using shotcrete or other spray applied concrete materials. Considerations for which option to be used will be made by the VA representative. Factors which may affect which option to be used may include: access to the work area; height of the area (such as is there sufficient height to use concrete materials in the area, etc.) Soils covered with permanent barriers **MUST HAVE PERMANENT SIGNAGE INSTALLED TO WARN AGAINST PENETRATION ASSOCIATED WITH POTENTIAL DISTURBANCE OF ASBESTOS.**

1. Remove ACS as shown on drawings to a minimum depth of 6 using wet methods. After wetting with amended water to minimize dust, shovel dirt into disposal bags. The CPIH/CIH shall closely monitor work conditions and take appropriate action to protect workers from over exposure to asbestos and heat stress. The minimum number of air changes per hour shall be six using negative air machines. Use special vacuum truck equipped with HEPA filtration to remove soil
2. Enclosure of ACS using a concrete layer of 4" over the entire surface may also be done. Thoroughly dampen soil first with amended water before pouring concrete. Personnel shall be proficient in concrete finishing as well as asbestos trained.

B. Crawlspace/Pipe Tunnels:

When working in crawlspaces or pipe tunnels, remove all visible asbestos debris using wet methods (if possible) after set-up of PDF, W/EDF, and after establishing negative air systems as required. Perform work and decontaminate/clean-up; perform lockdown as needed and complete work as required in these specifications. The asbestos contaminated soil (ACS) shall be removed and/or enclosed. Clearance requirements include confirmation sampling of affected soil by Polarized Light Microscopy (PLM). Clearance sampling requirements are specified in Sections 3.6.4 and 3.6.5.

Options for abatement of asbestos contaminated soil include: Removal of top 6 inches of soil; encapsulated the soil using shotcrete or other spray applied concrete materials. Considerations for which option to be used will be made by the VA representative. Factors which may affect which option to be used may include: access to the work area; height of the area (such as is there sufficient height to use concrete materials in the area, etc.)

3.3 LOCKDOWN ENCAPSULATION

3.3.1 GENERAL

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

3.3.2 DELIVERY AND STORAGE

Deliver materials to the job site in original, new and unopened containers bearing the manufacturer's name and label as well as the

following information: name of material, manufacturer's stock number, date of manufacture, thinning instructions, application instructions and the MSDS for the material.

3.3.3 WORKER PROTECTION

Before beginning work with any material for which an MSDS has been submitted, provide workers with any required personal protective equipment. The required personal protective equipment shall be used whenever exposure to the material might occur. In addition to OSHA/specification requirements for respiratory protection, a paint pre-filter and an organic vapor cartridge, at a minimum, shall be used in addition to the HEPA filter when an organic solvent based encapsulant is used. The CPIOH/CIH shall be responsible for provision of adequate respiratory protection. Note: Flammable and combustible encapsulants shall not be used, unless authorized in writing by the VA.

3.3.4 ENCAPSULATION OF SCRATCH COAT PLASTER OR PIPING

- A. Apply two coats of lockdown encapsulant to the scratch coat plaster or piping after all ACM has been removed. Apply in strict accordance with the manufacturer's instructions. Any deviation from the instructions must be approved by the VA's representative in writing prior to commencing the work.
- B. Apply the lockdown encapsulant with an airless sprayer at a pressure and using a nozzle orifice as recommended by the manufacturer. Apply the first coat while the scratch coat is still damp from the asbestos removal process, after passing the visual inspection. If the surface has been allowed to dry, wet wipe or HEPA vacuum prior to spraying with encapsulant. Apply a second coat over the first coat in strict conformance with the manufacturer's instructions. Color the lockdown encapsulant and contrast the color in the second coat so that visual confirmation of completeness and uniform coverage of each coat is possible. Adhere to the manufacturer's instructions for coloring. At the completion of the encapsulation, the surface must be a uniform third color produced by the mixture.

3.3.5 SEALING EXPOSED EDGES

Seal edges of ACM exposed by removal work which is inaccessible, such as a sleeve, wall penetration, etc., with two coats of bridging encapsulant. Prior to sealing, permit the exposed edges to dry completely to permit penetration of the bridging encapsulant. Apply in accordance with 3.3.4 (B).

3.4 DISPOSAL OF ACM WASTE MATERIALS

3.4.1 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. Transport will be in compliance with 49 CFR 100-185 regulations. Disposal shall be done at an approved landfill. Disposal of non-friable ACM shall be done in accordance with applicable regulations.

3.4.2 PROCEDURES

- A. The VA must be notified at least 24 hours in advance of any waste removed from the containment.
- B. 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 and wetted with amended water 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 goose necked 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 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.
- C. Waste Load Out: Waste load out shall be done in accordance with the procedures in W/EDF Decontamination Procedures. Sealed waste bags shall be decontaminated on exterior surfaces by wet cleaning and/or HEPA vacuuming before being placed in the second waste bag and sealed, which then must also be wet wiped or HEPA vacuumed.
- D. 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.

3.5 PROJECT DECONTAMINATION

3.5.1 GENERAL

- A. The entire work related to project decontamination shall be performed under the close supervision and monitoring of the CPIH/CIH.
- 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 cleanings of the surfaces of the regulated area 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.

3.5.2 REGULATED AREA CLEARANCE

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.

3.5.3 WORK DESCRIPTION

Decontamination includes the clearance air testing 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, and negative pressure systems.

3.5.4 PRE-DECONTAMINATION CONDITIONS

- A. Before decontamination starts, all ACM waste from the regulated area shall be collected and removed, and the loose 6 mil layer of poly removed while being adequately wetted with amended water 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. Primary barriers consisting of 2 layers of 6 mil poly on the floor and 4 mil poly on the walls.
 - 2. Critical barriers consisting of 2 layers of 6 mil poly which is the sole barrier between the regulated area and openings to the rest of the building or outside.
 - 4. Decontamination facilities for personnel and equipment in operating condition and the negative pressure system in operation.

3.5.5 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/air blowing methods. Use each surface of a wetted 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. Remove all filters in the air handling system and dispose of as ACM waste in accordance with these specifications. The negative pressure system shall remain in operation during this time. Additional cleaning(s) may be needed as determined by the CPIH/VPIH/CIH.

3.5.6 PRE-CLEARANCE INSPECTION AND TESTING

The CPIH/CIH and VPIH/CIH will perform a thorough and detailed visual inspection at the end of the cleaning to determine whether there is any visible residue in the regulated area. If the visual inspection is acceptable, the CPIH/CIH 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/CIH 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.

3.5.7 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. Negative pressure shall be maintained in the regulated area during the lockdown application.

3.6 FINAL VISUAL INSPECTION AND AIR CLEARANCE TESTING

3.6.1 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 starting after the final cleaning.

3.6.2 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.

3.6.3 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 clearance testing. Air samples will be collected and analyzed in accordance with procedures for AHERA in this specification. If work is less than 260 lf/160 sf/35 cf, 5 PCM samples shall be collected for clearance and a minimum of one field blank. If work is equal to or more than 260 lf/160 sf/35 cf, AHERA TEM sampling shall be performed for clearance. TEM analysis shall be done in accordance with procedures for EPA AHERA in this specification. If the release criteria are not met, the Contractor shall repeat the final cleaning and continue decontamination procedures until clearance is achieved. **All Additional inspection and testing costs will be borne by the Contractor.**
- B. If release criteria are met, proceed to perform the abatement closeout and to issue the certificate of completion in accordance with these specifications.

3.6.4 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 by the AHERA PCM protocol, or 70 AHERA structures per square millimeter (s/mm²) by AHERA TEM.
- 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 AHERA TEM method.
 2. Aggressive Sampling: All final air testing samples shall be collected using aggressive sampling techniques except where soil is not encapsulated or enclosed. Samples will be collected on 0.8μ MCE filters for PCM analysis and 0.45μ Polycarbonate filters for TEM. A minimum of 1200 Liters of using calibrated pumps shall be collected for clearance samples. Before pumps are started, initiate aggressive air mixing 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. The negative pressure system shall continue to operate.
 3. Final clearance for soil that is not encapsulated, samples will be collected on 0.8μ MCE filters for PCM analysis and 0.45μ

Polycarbonate filters for TEM. A minimum of 1200 Liters of using calibrated pumps shall be collected for clearance samples. Air clearance of work areas where contaminated soil has been removed is in addition to the requirement for clearance by bulk sample analysis discussed within these specifications. There will be no aggressive air sampling for the clearance of soil due to the fact that aggressive air sampling may overload the cassettes.

4. Random samples shall be collected from areas of soil which have been abated to ensure that the soil has been properly decontaminated. The total number of samples to be collected from the soil areas shall be; <1000 SF of soil - 3 samples; >1000 to <5000 SF of soil - 5 samples; and >5000 SF of soil - 7 samples. The soil samples shall be collected in a statistically random manner and shall be analyzed by PLM method. The clearance level to determine the soil clean is <1% asbestos by weight as analyzed by PLM method. If this level is achieved, the soil areas shall be considered clear. If the levels are >1% asbestos, the areas shall be re-cleaned until the sample results are <1%.

3.6.5 CLEARANCE SAMPLING USING PCM - LESS THAN 260LF/160SF:

- A. The VPIH/CIH will perform clearance samples as indicated by the specification.
- B. The NIOSH 7400 PCM method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 5 PCM clearance samples shall be collected. All samples must be equal to or less than 0.01 f/cc to clear the regulated area.
- C. Random samples shall be collected from areas of soil which have been abated to ensure that the soil has been properly decontaminated. The total number of samples to be collected from the soil areas shall be; <1000 SF of soil - 3 samples; >1000 to <5000 SF of soil - 5 samples; and >5000 SF of soil - 7 samples. The soil samples shall be collected in a statistically random manner and shall be analyzed by PLM method. The clearance level to determine the soil clean is <1% asbestos by weight as analyzed by PLM method. If this level is achieved, the soil areas shall be considered clear. If the levels are >1% asbestos, the areas shall be re-cleaned until the sample results are <1%.

3.6.6 CLEARANCE SAMPLING USING TEM - EQUAL TO OR MORE THAN 260LF/160SF: TEM

- A. Clearance requires 13 samples be collected; 5 inside the regulated area; 5 outside the regulated area; and 3 field blanks.
- B. The TEM method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 13 clearance samples shall be collected. All samples must be equal to or less than 70 AHERA structures per square millimeter (s/mm²) AHERA TEM.

3.6.7 LABORATORY TESTING OF PCM CLEARANCE SAMPLES

The services of an AIHA accredited laboratory will be employed by the VA to perform analysis for the PCM air samples. The accredited laboratory shall be successfully participating in the AIHA Proficiency Analytical Testing (PAT) program. Samples will be sent daily 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.

3.6.8 LABORATORY TESTING OF TEM SAMPLES

Samples shall be sent by the VPIH/CIH to a NIST accredited laboratory for analysis by TEM. The laboratory shall be successfully participating in the NIST Airborne Asbestos Analysis (TEM) program. 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.

3.6.9 LABORATORY TESTING OF BULK SAMPLES

Samples shall be sent by the VPIH/CIH or CPIH/CIH to a NIST accredited laboratory for analysis by PLM. The laboratory shall be successfully participating in the NIST Bulk Asbestos Analysis (PLM) program. 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.

3.7 ABATEMENT CLOSEOUT AND CERTIFICATE OF COMPLIANCE

3.7.1 COMPLETION OF ABATEMENT WORK

After thorough decontamination, seal negative air machines with 2 layers of 6 mil poly and duct tape to form a tight seal at the intake/outlet ends before removal from the regulated area. Complete asbestos abatement work upon meeting the regulated area visual and air clearance criteria and fulfilling the following:

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

3.7.2 CERTIFICATE OF COMPLETION BY CONTRACTOR

The CPIH/CIH 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.

3.7.3 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.

3.7.4 RE-INSULATION

If required as part of the contract, replace all asbestos containing insulation/fire-proofing with suitable non-asbestos material. Provide MSDS's for all replacement materials in advance of installation for VA approval. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

ATTACHMENT #1

CERTIFICATE OF COMPLETION

DATE: _____ VA Project #: _____

PROJECT NAME: _____ Abatement Contractor: _____

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 abatement work was done in accordance with OSHA requirements and the manufacturer's recommendations.

CPIH/CIH Signature/Date: _____

CPIH/CIH Print Name: _____

Abatement Contractor Signature/Date: _____

Abatement Contractor Print Name: _____

ATTACHMENT #2

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME: _____ DATE: _____

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: _____

Printed Name: _____

Social Security Number: _____

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/CIH: _____ Date: _____

Printed Name of CPIH/CIH: _____

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 _____

- - END- - - -

**SECTION 02 82 13.13
GLOVEBAG ASBESTOS ABATEMENT**

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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 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 Asbestos Abatement Contractor. All costs incurred due to such action are also the responsibility of the Asbestos Abatement Contractor.

NOTE: Part 56 of Title 12 of the Official Compilation of Codes, Rules and Regulations of the State of New York (Cited as 12 NYCRR Part 56) are the presiding regulations having jurisdiction over the work. Wherever 12 NYCRR Part 56 are more stringent than any requirements stated herein, all applicable provisions of 12 NYCRR Part 56 shall be adhered to as if stated herein in it's entirety.

1.1.2 EXTENT OF WORK

- A. Below is a brief description of the estimated quantities of asbestos containing materials to be abated by the tent & glovebag method. These quantities are for informational purposes only and are based on the best information available at the time of the specification preparation. The Contractor shall satisfy himself as the actual quantities to be abated. Nothing in this section may be interpreted as limiting the extent of work otherwise required by this contract and related documents.
- B. Removal, clean-up and disposal of ACM piping insulation/ in an appropriate regulated area in the following approximate quantities:
 - 12 feet of >4" diameter pipe insulation

1.1.3 RELATED WORK

- A. Section 02 41 00, DEMOLITION.
- B. Section 07 84 00, FIRESTOPPING.
- C. Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION / Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING / Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION
- D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

1.1.4 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 Asbestos Hazard Abatement Plans 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.

1.1.5 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 VA Design and Construction Procedures. VA Design and Construction Procedures 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.

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 estimated, which are limited by the physical constraints imposed by occupancy of the buildings and accessibility to ACM. 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 newly discovered ACM and those prices shall be used for additional work required under the contract.

1.3 STOP ASBESTOS REMOVAL

If the Contracting Officer; their field representative; (the facility Safety Officer/Manager or their designee, or the VA Professional Industrial Hygienist/ Certified Industrial Hygienist (VPIH/CIH) presents a verbal **Stop Asbestos Removal Order**, the Contractor/Personnel shall immediately stop all asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM. If a verbal Stop Asbestos Removal Order is issued, the VA shall follow-up with a written order to the Contractor as soon as it is practicable. The Contractor shall not resume any asbestos removal activity until authorized to do so in writing by the VA Contracting Officer. A stop asbestos removal order may be issued at any time the VA Contracting Officer determines abatement conditions/activities are not within VA specification, regulatory requirements or that an imminent

hazard exists to human health or the environment. 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 VPIH/CIH time. The occurrence of any of the following events shall be reported immediately by the Contractor's competent person to the VA Contracting Office or field representative using the most expeditious means (e.g., verbal or telephonic), followed up with written notification to the Contracting Officer as soon as practical. The Contractor shall immediately stop asbestos removal/disturbance activities and initiate fiber reduction activities:

- A. Airborne PCM analysis results equal to or greater than 0.01 f/cc outside a regulated area or >0.05 f/cc inside a regulated area;
- B. breach or break in regulated area containment barrier(s);
- C. less than -0.02" WCG pressure in the regulated area;
- D. serious injury/death at the site;
- E. fire/safety emergency at the site;
- F. respiratory protection system failure;
- G. power failure or loss of wetting agent; or
- H. 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. Includes removal, encapsulation, enclosure, demolition, and renovation activities related to asbestos containing materials (ACM).

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. For personal samples and clearance air testing using Phase Contrast Microscopy (PCM) analysis. NIOSH Method 7402 can be used when it is necessary to confirm fibers counted by PCM as being asbestos. The AHERA TEM analysis may be used for background, area samples and clearance

samples when required by this specification, or at the discretion of the VPIH/CIH as appropriate.

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 Hazard Abatement Plan (AHAP) - Asbestos work procedures required to be submitted by the contractor before work begins.

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

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

Asbestos-contaminated soil (ACS) - Soil found in the work area or in adjacent areas such as crawlspaces or pipe tunnels which is contaminated with asbestos-containing material debris and cannot be easily separated from the material.

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

Asbestos Project Monitor - Some states require that any person conducting asbestos abatement clearance inspections and clearance air sampling be licensed as an asbestos project monitor.

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 representative having jurisdiction over the regulated area (e.g., OSHA, Federal and State EPA).

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 - Plastic barriers placed over critical barriers and exposed directly to abatement work.

Secondary Barrier - Any additional plastic barriers 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) - A person certified in the comprehensive practice of industrial hygiene 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 professional industrial hygiene consultant/Certified Industrial Hygienist (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/CIH) - The asbestos abatement contractor's industrial hygienist. The industrial hygienist must meet the qualification requirements of a PIH and may be a certified industrial hygienist (CIH).

Count - Refers to the fiber count or the average number of fibers greater than five microns in length with a length-to-width (aspect) ratio of at least 3 to 1, per cubic centimeter of air.

Crawlspace - An area which can be found either in or adjacent to the work area. This area has limited access and egress and may contain asbestos materials and/or asbestos contaminated soil.

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.

VA Total - means a building or substantial part of the building is completely removed, torn or knocked down, bulldozed, flattened, or razed, including removal of building debris.

Disposal bag - Typically 6 mil thick sift-proof, dustproof, leak-tight 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 and 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 sift-proof, dustproof, and leak-tight.

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 (aspect) 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 one (1) percent or 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 - An ASHRAE MERV 17 filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers 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 (IH) - 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 (IH 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. Some states require that an industrial hygienist technician conducting asbestos abatement clearance inspection and clearance air sampling be licensed as an asbestos project monitor.

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) - EPA's rule to control emissions of asbestos to the environment (40 CFR Part 61, Subpart M).

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.

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 column 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 pressure outside the respirator facepiece.

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 to remove organic vapor hazardous air contaminants.

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 protective equipment (PPE) - equipment designed to protect user from injury and/or specific job hazard. Such equipment may include protective clothing, hard hats, safety glasses, and respirators.

Personal sampling/monitoring - Representative air samples obtained in the breathing zone for one or more workers within the regulated area using a filter cassette and a calibrated air sampling 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 eight (8) hour time weighted average PEL is 0.1 fibers per cubic centimeter (0.1 f/cc) of air and the 30-minute Excursion Limit is 1.0 fibers per cubic centimeter (1 f/cc).

Pipe tunnel - An area, typically located adjacent to mechanical spaces or boiler rooms in which the pipes servicing the heating system in the building are routed to allow the pipes to access heating elements. These areas may contain asbestos pipe insulation, asbestos fittings, or asbestos-contaminated soil.

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, flame retardant per NFPA 241.

Positive/negative fit check - A method of verifying the seal of a facepiece respirator by temporarily occluding the filters and breathing in (inhaling) and then temporarily occluding the exhalation valve and breathing out (exhaling) while checking for inward or outward leakage of the respirator respectively.

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 (b).

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. The PIH may be either the VA's PIH (VPIH) or Contractor's PIH (CPIH/CIH).

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).

Assigned Protection factor - A value assigned by OSHA/NIOSH to indicate the expected protection provided by each respirator class, when the respirator is properly selected and worn correctly. The number indicates the reduction of exposure level from outside to inside the respirator facepiece.

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 non-friable ACM that has become friable; Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading or; Category II non-friable 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.

Supplied air respirator (SAR) - A respiratory protection system that supplies minimum Grade D respirable air per ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989.

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 Professional Industrial Hygienist (VPIH/CIH) - The Department of Veterans Affairs Professional Industrial Hygienist must meet the qualifications of a PIH, and may be a Certified Industrial Hygienist (CIH).

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/ACS or ACM waste material.

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

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

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
- I. NIST National Institute for Standards and Technology
U. S. Department of Commerce
Gaithersburg, MD 20234
301-921-1000
- K. NEC National Electrical Code (by NFPA)
- L. NEMA National Electrical Manufacturer's Association
2101 L Street, NW
Washington, DC 20037
- M. NFPA National Fire Protection Association
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
800-344-3555
- N. NIOSH National Institutes for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, OH 45226
513-533-8236
- O. OSHA Occupational Safety and Health Administration
U.S. Department of Labor
Government Printing Office
Washington, DC 20402
- P. UL Underwriters Laboratory
333 Pfingsten Rd.
Northbrook, IL 60062
312-272-8800

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 ASBESTOS ABATEMENT CONTRACTOR RESPONSIBILITY

The Asbestos Abatement Contractor (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 asbestos abatement project. The Contractor is responsible for providing and maintaining training, accreditations, medical exams, medical records, personal protective equipment (PPE) including respiratory protection including respirator fit testing, as required by applicable Federal, State and Local regulations. The Contractor shall hold the VA and VPIH/CIH consultants harmless for any Contractor's 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/CIH, including all sampling/analytical costs to assure compliance with OSHA/EPA/State requirements related to failure to comply with the regulations applicable to the work.

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 Subpart I - Personal Protective Equipment
 - 3. Title 29 CFR 1910.134 - Respiratory Protection
 - 4. Title 29 CFR 1926 - Construction Industry Standards
 - 5. Title 29 CFR 1910.1020 - Access to Employee Exposure and Medical Records
 - 6. Title 29 CFR 1910.1200 - Hazard Communication
 - 7. Title 29 CFR 1910 Subpart K - 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 STATE REQUIREMENTS:

State requirements that apply to the asbestos abatement work, disposal, clearance, etc., include, but are not limited to, the following:

A. New York State Department of Environmental Conservation (DEC) 6NYCRR:

1. Part 360 Solid Waste Management Facilities.
2. Part 364 Waste Transporter Permits.
3. Part 370 Hazardous Waste Management System-General.
4. Part 371 Identification and Listing of Hazardous Wastes.
5. Part 372 Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities.
6. Part 373 Hazardous Waste Management Facilities.

B. New York State Department of Labor (DOL): Industrial Code Rule 56.

1.5.5 LOCAL REQUIREMENTS - NOT USED**1.5.6 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 and ANSI 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

1.5.7 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

1.5.8 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 are given to EPA, State, and Local authorities.

1.5.9 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.

1.5.10 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.

1.5.11 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, calibration data and method of analysis. 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.

1.5.12 EMERGENCY ACTION PLAN AND ARRANGEMENTS

- A. An Emergency Action Plan shall be developed by 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 in the clean room and equipment room of the decontamination unit. 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; layout of regulated area; and access to the 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 any/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 3-4 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 Asbestos Hazard Abatement Plans during abatement. Such incidents include, but are not limited to, fire; accident; power failure; negative pressure failure; and supplied air system failure. The Contractor shall detail procedures to be followed in the event of an incident assuring that asbestos abatement work is stopped and wetting is continued until correction of the problem.

1.5.14 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 Asbestos Hazard Abatement Plan. In these procedures, the following information must be detailed, specific for this project. A copy of the Contractor's Asbestos Hazard Abatement Plan (AHAP) 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; and

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.
- K. Asbestos Site Specific Variance Submittals; if a site specific variance is sought submit the following:
 1. One copy of the completed DOSH-751 and DOSH-465 forms.
 2. One copy of the New York State Department of Labor site specific variance decision.
- L. Quality Control Submittals:
 1. Notification Compliance Data: Within 2 days after notification is sent to the regulatory agencies submit one copy of each notice sent to each regulatory agency (USEPA and DOL).
 2. Asbestos Removal Company Data: Name and address of proposed asbestos removal company and abatement contractor license issued by DOL.
 3. Asbestos Worker Certification Data: Name and address of proposed asbestos abatement workers and licenses issued by DOL.
 4. Work Plan: For information only, submit one copy of the work plan required under Quality Assurance Article.
 5. Waste Transporter Permit: One copy of transporter's current waste transporter permit from NYS DEC (NYS Part 364 Permit).
 6. Landfill: Landfill to be used for ACM disposal shall be licensed to receive asbestos waste by NYS DEC (NYS Part 360 Permit) and by USEPA. Out of state landfills shall provide licenses from local agencies having jurisdiction.
 7. Negative Air Pressure Equipment: Copy of manufacturer's and performance data of all units and HEPA filters used.
- M. Asbestos Work Closeout Submittals:
 1. Waste Shipment Records and Disposal Site Receipts: Copy of waste shipment record and disposal site receipt showing that the ACM has been properly disposed.
 - a. Waste shipment record and disposal site receipt must be received within 35 days of the ACM waste leaving the Site. If receipts are not received within the specified time period, the Director's Representative will notify USEPA in writing within 45 days of the ACM waste leaving the Site.
- O. Contract Closeout Submittals:
 1. Daily Log: Submit copy of Project Monitor's daily air sample log and a copy of Asbestos Abatement Contractor's Daily project log.
 2. Air Monitoring Data: Submit copy of air test results and chain of custody.

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(s) 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 color 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 federal (and state as applicable) EPA and OSHA asbestos regulations in the past three (3) years; has adequate liability/occurrence insurance for asbestos work as required by the state; is licensed in applicable states; has adequate and qualified personnel available to complete the work; has comprehensive Asbestos Hazard Abatement Plans (AHAPs) for asbestos work; and 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 within the past three (3) years; 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/CIH (CPIH/CIH) 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 Asbestos Hazard Abatement Plan 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 or equivalent, 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 Asbestos Hazard Abatement Plans of the Contractor; has one year of asbestos abatement experience within the past three (3) years of similar size

and complexity; has applicable medical and respiratory protection documentation; has certificate of training/current refresher and State accreditation/license.

All personnel should be in compliance with OSHA construction safety training as applicable and submit certification.

1.7 RESPIRATORY PROTECTION

1.7.1 GENERAL - RESPIRATORY PROTECTION PROGRAM

The Contractor shall develop and implement a written 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 Subpart I;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 RPP 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 RPP of similar size and complexity. The RPPC must submit 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 qualifications. 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 or other licensed health care professional has provided a written determination they are medically qualified to wear the class of respirator to be used on the project while wearing whole body impermeable garments and subjected to heat or cold stress.

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 pressure user seal check is done each time the respirator is donned by an employee. Head coverings must cover respirator head straps. Any situation that prevents an effective facepiece to face seal as evidenced by failure of a user seal check shall preclude that person from wearing a respirator inside the regulated area 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. A current physician's written opinion as required by 29 CFR 1926.1101 (m)(4) shall be provided for each person and shall include in the medical opinion the person has been evaluated for working in a heat and cold stress environment while wearing personal protective equipment (PPE) and is able to perform the work without risk of material health impairment.

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

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

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 inhaling 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 decontamination facilities (PDF) and waste/equipment decontamination facilities (W/EDF). Ensure that the PDF are 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 must go through the PDF and shall follow the requirements at 29 CFR 1926.1101 (j)(1) and these specifications. All waste, equipment and contaminated 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. Weight inner doorway 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 and reduce potential for non-authorized personnel entering the regulated area.

1.9.3 TEMPORARY FACILITIES TO THE PDF AND W/EDF

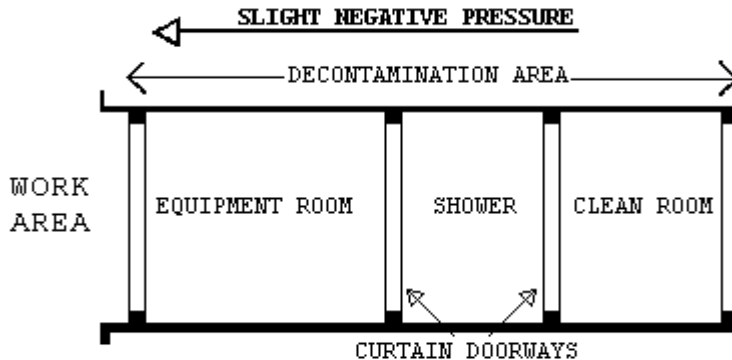
The Competent Person shall provide temporary water service connections to the PDF and W/EDF. Backflow prevention must be provided at the point of connection to the VA system. Water supply must be of adequate pressure and meet requirements of 29 CFR 1910.141(d)(3). Provide adequate temporary overhead electric power with ground fault circuit interruption (GFCI) protection. Provide a sub-panel equipped with GFCI protection 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, if needed, 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 insure 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 3 layers of 6 mil opaque fire retardant poly to provide an air tight room. Provide a minimum of 2 - 900 mm (3 foot) wide 6 mil poly opaque fire retardant 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. Provide 1 storage locker per person. A portable fire extinguisher, minimum 10 pounds capacity, 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

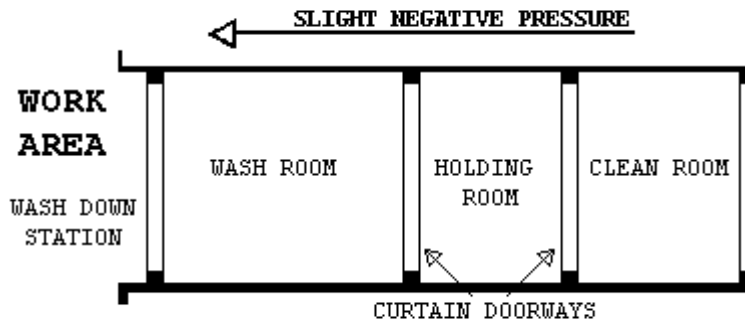
- entry points to the PDF so no male can enter or exit the PDF during her stay in the PDF.
2. Shower Room: The Competent Person shall assure that the shower room is a completely water tight compartment to be used for the movement of all personnel from the clean room to the equipment room and for the showering of all personnel going from the equipment room 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 opaque 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 once per day 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/tools, reusable personal protective equipment, except for a respirator and for use as a gross decontamination area for personnel exiting the regulated area. The equipment room shall be separated from the regulated area by a minimum 3 foot wide door made with 2 layers of 6 mil opaque 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 opaque 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. If needed, provide a temporary electrical sub-panel equipped with GFCI in the equipment room to accommodate any equipment required in the regulated area.
 4. The PDF shall be as follows: 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 shall be a minimum of 2 layers of 6 mil opaque 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 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 exterior of the regulated area. 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 2 layers of 6 mil fire retardant poly. When a negative pressure differential system is used, a rigid enclosure separation between the W/EDF clean room and the adjacent areas shall be provided.
5. The W/EDF shall be 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 the washdown station in the regulated area, thoroughly wet wipe/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/CIH has submitted verification to the VA's representative.

- 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 and combustible materials cannot be stored inside buildings. Replacement materials shall be stored outside of the regulated 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 location.
- 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. Polyethylene sheeting for walls in the regulated area shall be a minimum of 4-mils. For floors and all other uses, sheeting of at least

- 6-mils shall be used in widths selected to minimize the frequency of joints. Fire retardant poly shall be used throughout.
- F. 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. Method of attachment may include any combination of moisture resistant duct tape furring strips, spray glue, staples, nails, screws, lumber and plywood for enclosures or other effective procedures capable of sealing polyethylene to dissimilar finished or unfinished surfaces under both wet and dry conditions.
 - G. Polyethylene sheeting utilized for the PDF 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, 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. All electrically operated hand tools, equipment, electric cords shall be connected to 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 poly 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 an advance copy of the MSDS as required for all hazardous chemicals under OSHA 29 CFR 1910.1200 - Hazard Communication in the pre-project submittal. Chlorinated compounds shall not be used with any spray adhesive, mastic remover 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 written 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. OSHA requires that the Employee exposure to asbestos must not exceed 0.1 fibers per cubic centimeter (f/cc) of air, averaged over an 8-hour work shift. The CPIH/CIH is responsible for and shall 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/CIH 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/CIH with review and approval of the VPIH/CIH. An agreement between the CPIH/CIH 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. The VPIH/CIH will perform the following tasks:
1. Task 1: Establish background levels before abatement begins by collecting background samples. Retain samples for possible TEM analysis.
 2. Task 2: Perform continuous air monitoring, inspection, and testing outside the regulated area during actual abatement work to detect any faults in the regulated area isolation and any adverse impact on the surroundings from regulated area activities.
 3. Task 3: Perform unannounced visits to spot check overall compliance of work with contract/specifications. These visits may include any inspection, monitoring, and testing inside and outside the regulated area and all aspects of the operation except personnel monitoring.
 4. Task 4: Provide support to the VA representative such as evaluation of submittals from the Contractor, resolution of unforeseen developments, etc.
 5. Task 5: Perform, in the presence of the VA representative, final inspection and testing of a decontaminated regulated area or building at the conclusion of the abatement and clean-up work to certify compliance with all regulations and the VA requirements/specifications.
 6. Task 6: Issue certificate of decontamination for each regulated area or building and project report.
- 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/CIH

The Contractor's CPIH/CIH 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/CIH 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 sampling and analysis. The IH Technician shall have successfully completed a NIOSH 582 Course or equivalent and provide documentation. 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 AHERA/State Contractor/Supervisor (or Abatement Worker) and Building Inspector. The IH Technician shall have participated in five abatement projects collecting personal and area samples as well as responsibility for documentation on substantially similar projects in size and scope. The analytic laboratory used by the Contractor to analyze the samples shall be AIHA accredited for asbestos PAT and approved by the VA prior to start of the project. A daily log shall be maintained by the CPIH/CIH or IH Technician, documenting all OSHA requirements for air personal 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 upon request. The log will contain, at a minimum, information on personnel or area samples, 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/CIH 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/CIH will perform inspection and testing at the final stages of abatement for each regulated area as specified in the CPIH/CIH responsibilities. Additionally, the CPIH/CIH will monitor and record pressure readings within the containment daily with a minimum of two readings at the beginning and at the end of a shift, and submit the data in the daily report.

2.4 ASBESTOS HAZARD ABATEMENT PLAN

The Contractor shall have established Asbestos Hazard Abatement Plan (AHAP) 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 AHAP must be modified as needed to address specific requirements of the project. The AHAP 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 AHAP(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-START 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 Asbestos Hazard Abatement Plan developed specifically for this project, incorporating the requirements of the specifications, prepared, signed and dated by the CPIH/CIH.
- D. Submit the specifics of the materials and equipment to be used for this project with manufacturer names, model numbers, performance characteristics, pictures/diagrams, and number available for the following:
 1. Supplied air system, negative air machines, HEPA vacuums, air monitoring pumps, calibration devices, pressure differential monitoring device and emergency power generating system.
 2. Waste water filtration system, shower system, containment barriers.
 3. Encapsulants, surfactants, hand held sprayers, airless sprayers, glovebags, and fire extinguishers.
 4. Respirators, protective clothing, 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. Personal air monitoring must be done in accordance with OSHA 29 CFR 1926.1101(f) and Appendix A. And area or clearance air monitoring in accordance with EPA AHERA protocols.
- 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; and 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; and Resolution.

3. List asbestos regulatory citations (e.g., OSHA), notices of violations (e.g., Federal and state EPA), penalties, and legal actions taken against the company including and of the company's officers (including damages paid) 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; copies of certificates, accreditations, and licenses. Submit an affidavit signed by the CPIH/CIH 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 written respiratory protection program, and maintains recordkeeping in accordance with the above regulations. Submit the phone number and doctor/clinic/hospital used for medical evaluations.
 1. CPIH/CIH and IH Technician: 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 AHAP(s) developed; medical opinion; and 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 in size/complexity 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 (asbestos surveillance and respirator use); and 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 (asbestos surveillance and respirator use); and 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 language the coverage provided and the fact that asbestos abatement activities are covered by the policy; copy of AHAP(s) incorporating the requirements of this specification; information on who provides your training, how often; who provides medical surveillance, how often; who performs and how is personal air monitoring of abatement workers conducted; a list of references of independent laboratories/IH's familiar with your air monitoring and Asbestos Hazard Abatement Plans; copies of monitoring results of the five referenced projects listed and analytical method(s) used.
 - K. Rented equipment must be decontaminated prior to returning to the rental agency.
 - L. Submit, before the start of work, the manufacturer's technical data for all types of encapsulants, all MSDS, and application instructions.

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 barrier breeching, equipment failures, emergencies, and any cause for stopping work; representative

air monitoring and results/TWAs/ELs. Submit this information daily to the VPIH/CIH.

- B. The CPIH/CIH shall document and maintain the inspection and approval of the regulated area preparation prior to start of work and daily during work.
 - 1. Removal of any poly barriers.
 - 2. Visual inspection/testing by the CPIH/CIH or IH Technician prior to application of lockdown encapsulant.
 - 3. Packaging and removal of ACM waste from regulated area.
 - 4. 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/CIH 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. It will also include information on the containment and transportation of waste from the containment with applicable Chain of Custody forms. The report shall include a certificate of completion, signed and dated by the CPIH/CIH, in accordance with Attachment #1. All clearance and perimeter area samples must be submitted. The VA Representative will retain the abatement report after completion of the project and provide copies of the abatement report to VAMC Office of Engineer and the Safety Office.

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 REGULATED AREA PREPARATIONS

3.1.1 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 require any unauthorized person to leave the regulated area and then notify the VA Contracting Officer or VA Representative using the most expeditious means.
- 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. 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. In any situation where exposure to high temperatures which may result in a flame hazard, fire retardant poly sheeting must be used.
- 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 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 Representative or Competent Person. The VA Police should be informed of asbestos abatement regulated areas to provide security checks during facility rounds and emergency response.

3.1.2 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.

3.1.3.1 SHUT DOWN - LOCK OUT ELECTRICAL

Shut down and lock out/tag out electric power to the regulated area. Provide temporary power and lighting. Insure 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.

3.1.3.2 SHUT DOWN - LOCK OUT HVAC

Shut down and lock out/tag 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.

3.1.4 CONTAINMENT BARRIERS AND COVERINGS FOR THE REGULATED AREA

3.1.4.1 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.

3.1.4.2 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.

3.1.4.3 CONTROLLING ACCESS TO THE REGULATED AREA

Access to the regulated area is allowed only through the personnel decontamination facility (PDF). 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 to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid and capable of withstanding the negative pressure.

3.1.4.4 CRITICAL BARRIERS

The regulated area must be completely separated from the adjacent area(s) 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.

3.1.4.5 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.

3.1.4.6 FLOOR BARRIERS:

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

3.1.5 SANITARY FACILITIES

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

3.1.6 PRE-CLEANING

3.1.6.1 PRE-CLEANING MOVABLE OBJECTS

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.

Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area. PPE must be donned by all workers performing pre-cleaning activities. After items have been pre-cleaned and decontaminated, they may be removed from the work area for storage until the completion of abatement in the work area.

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.

3.1.6.2 PRE-CLEANING FIXED OBJECTS

Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area.

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 pre-cleaning, 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.

3.1.6.3 PRE-CLEANING SURFACES IN THE REGULATED AREA

Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work 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.

3.1.7 PRE-ABATEMENT ACTIVITIES

3.1.7.1 PRE-ABATEMENT MEETING

The VA representative, upon receipt, review, and substantial approval of all pre-abatement submittals and verification by the CPIH/CIH 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/CIH, 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.

3.1.7.2 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 VA A/E Quality Alert 07/09 indicating the failure to identify asbestos in the areas listed as well as common issues when preparing specifications and contract documents. This is especially critical when demolition is planned, because AHERA surveys are non-destructive, and ACM may remain undetected. A NESHAPS (destructive) ACM inspection should be conducted on all building structures that will be demolished. Ensure the following areas are inspected on the project: Lay-in ceilings concealing ACM; ACM behind walls/windows from previous renovations; inside utility chases/walls; transite piping/ductwork/sheets; behind radiators; lab fume hoods; transite lab countertops; roofing materials; below window sills; water/sewer lines; electrical conduit coverings; crawl spaces (previous abatement contamination); flooring/mastic covered by carpeting/new flooring; exterior insulated wall panels; on underground fuel tanks; and steam line trench coverings.
- C. Ensure that all furniture, machinery, equipment, curtains, drapes, blinds, and other movable objects required to be removed from the regulated area have been cleaned and removed or properly protected from contamination.
- D. If present and required, remove and dispose of carpeting from floors in the regulated area.
- E. Inspect existing firestopping in the regulated area. Correct as needed.

3.1.7.3 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/CIH 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 AHAP(s), especially worker protection, respiratory systems, contingency plans, decontamination procedures, and monitoring to demonstrate satisfactory operation.

- C. The CPIH/CIH 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 REMOVAL OF PIPING ACM

3.2.1 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.

3.2.2 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 cover floors and any walls within 10 feet (3 meters) of the area where work is to be done. Secure the secondary barrier with duct tape to prevent it from moving or 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 black poly between the regulated area and the decontamination facilities (PDF and W/EDF) to protect the primary layers from contamination and damage. Install the walkways at the beginning of each shift and remove at the end of each shift.

3.2.3 WET REMOVAL OF ACM

- A. Using acceptable glovebag procedures, adequately and thoroughly wet the ACM to be removed prior to removal with amended water or when authorized by VA, removal encapsulant to reduce/prevent fiber release to the air. Adequate time (at a minimum two hours) must be allowed for the amended water or removal encapsulant 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 when authorized in writing by the VPIH/CIH and VA when a greater safety hazard (e.g., electricity) is present**

3.3 GLOVEBAG REMOVAL PROCEDURES

3.3.1 GENERAL

All applicable OSHA requirements and glovebag manufacturer's recommendations shall be met during glove bagging operations. In cases where live steam lines are present, the lines must be shut down prior to any work being performed on the system. **No abatement work shall be conducted on live, pressurized steam lines.** The Contractor may choose to use a High Temperature Glovebag in which a temperature rating ranges from 300°F to 700°F on steam lines that have recently been shut down and remain at high temperature for some time. In the case where a glovebag is not feasible, the Contractor will need to build a full negative pressure containment of sufficient size and follow all regulations as it pertains to removal.

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.

3.3.2 NEGATIVE PRESSURE GLOVEBAG PROCEDURE

1. In addition to the above requirements, the HEPA vacuum shall be run continuously during the glovebag procedure until completion at which time the glovebag will be collapsed by the HEPA vacuum prior to removal from the pipe/component.
2. The HEPA vacuum shall be attached and operated as needed to prevent collapse of the glovebag during the removal process.

3.4 LOCKDOWN ENCAPSULATION

3.4.1 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.

3.4.2 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.

3.5 DISPOSAL OF ACM WASTE MATERIALS

3.5.1 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. Transport will be in compliance with 49 CFR 100-185 regulations. Disposal shall be done at an approved landfill. Disposal of non-friable ACM shall be done in accordance with applicable regulations.

3.5.2 PROCEDURES

- A. The VA must be notified at least 24 hours in advance of any waste removed from the containment
- B. 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 and wetted with amended water 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 goose necked 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.

- C. Waste Load Out: Waste load out shall be done in accordance with the procedures in W/EDF Decontamination Procedures. Sealed waste bags shall be decontaminated on exterior surfaces by wet cleaning and/or HEPA vacuuming before being placed in the second waste bag and sealed, which then must also be wet wiped or HEPA vacuumed..
- D. 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.

3.6 PROJECT DECONTAMINATION

3.6.1 GENERAL

- A. The entire work related to project decontamination shall be performed under the close supervision and monitoring of the CPIH/CIH.
- 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 cleanings of the surfaces of the regulated area 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.

3.6.2 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.

3.6.3 WORK DESCRIPTION

Decontamination includes the clearance air testing 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, and negative pressure systems.

3.6.4 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.
 2. Decontamination facilities, if required for personnel and equipment in operating condition.

3.6.5 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/air blowing methods. Use each surface of a wetted 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. Remove all filters in the air handling system and dispose of as ACM waste in accordance with these specifications. The negative pressure system shall remain in operation during this time. Additional cleaning(s) may be needed as determined by the CPIH/VPIH/CIH.

3.6.6 PRE-CLEARANCE INSPECTION AND TESTING

The CPIH/CIH and VPIH/CIH will perform a thorough and detailed visual inspection at the end of the cleaning to determine whether there is any visible residue in the regulated area. If the visual inspection is acceptable, the CPIH/CIH 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/CIH 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.

3.6.7 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.

3.7 FINAL VISUAL INSPECTIONS AND AIR CLEARANCE TESTING

3.7.1 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.

3.7.2 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.

3.7.3 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 clearance testing. Air samples will be collected and analyzed in accordance with procedures for AHERA in this specification. If work is less than 260 lf/160 sf/35 cf, 5 PCM samples shall be collected for clearance and a minimum of one field blank. If work is equal to or more than 260 lf/160 sf/35 cf, AHERA TEM sampling shall be performed for clearance. TEM analysis shall be done in accordance with procedures for EPA AHERA in this specification. If the release criteria are not met, the Contractor

shall repeat the final cleaning and continue decontamination procedures until clearance is achieved. All additional inspection and testing costs will be borne by the Contractor.

- B. If release criteria are met, proceed to perform the abatement closeout and to issue the certificate of completion in accordance with these specifications.

3.7.4 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 by the AHERA PCM protocol, or 70 AHERA structures per square millimeter (s/mm²) by AHERA TEM.
- 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 AHERA TEM method.
 2. Aggressive Sampling: All final air testing samples shall be collected using aggressive sampling techniques except where soil is not encapsulated or enclosed. Samples will be collected on 0.8μ MCE filters for PCM analysis and 0.45μ Polycarbonate filters for TEM. A minimum of 1200 Liters of using calibrated pumps shall be collected for clearance samples. Before pumps are started, initiate aggressive air mixing 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. The negative pressure system shall continue to operate.

3.7.5 CLEARANCE SAMPLING USING PCM

- A. The VPIH/CIH will perform clearance samples as indicated by the specification.
- B. The NIOSH 7400 PCM method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 5 PCM clearance samples shall be collected. All samples must be equal to or less than 0.01 f/cc to clear the regulated area.

3.7.6 CLEARANCE SAMPLING USING TEM

- A. Clearance requires 13 samples be collected; 5 inside the regulated area; 5 outside the regulated area; and 3 field blanks.
- B. The TEM method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 13 clearance samples shall be collected. All samples must be equal to or less than 70 AHERA structures per square millimeter (s/mm²) AHERA TEM.

3.7.7 LABORATORY TESTING OF PCM SAMPLES

The services of an AIHA accredited laboratory will be employed by the VA to perform analysis for the PCM air samples. The accredited laboratory shall be successfully participating in the AIHA Proficiency Analytical Testing (PAT) program. Samples will be sent daily 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.

3.7.8 LABORATORY TESTING OF TEM SAMPLES

Samples shall be sent by the VPIH/CIH to a NIST accredited laboratory for analysis by TEM. The laboratory shall be successfully participating in the NIST Airborne Asbestos Analysis (TEM) program. 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

3.8 ABATEMENT CLOSEOUT AND CERTIFICATE OF COMPLIANCE

3.8.1 COMPLETION OF ABATEMENT WORK

After thorough decontamination, seal negative air machines with 2 layers of 6 mil poly and duct tape to form a tight seal at the intake/outlet ends before removal from the regulated area. Complete asbestos abatement work upon meeting the regulated area visual and air 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. 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. Transport will be in compliance with 49 CFR 100-185 regulations.
- C. Repair or replace all interior finishes damaged during the abatement work.
- D. The VA will be notified of any waste removed from the containment prior to 24 hours.
- E. Fulfill other project closeout requirements as specified elsewhere in this specification.

3.8.2 CERTIFICATE OF COMPLETION BY CONTRACTOR

The CPIH/CIH 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.

3.8.3 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.

3.8.4 RE-INSULATION

If required as part of the contract, replace all asbestos containing insulation with suitable non-asbestos material. Provide MSDS for all replacement materials. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

ATTACHMENT #1

CERTIFICATE OF COMPLETION

DATE: _____ VA Project #: _____

PROJECT NAME: _____ Abatement Contractor: _____

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/CIH Signature/Date: _____

CPIH/CIH Print Name: _____

Abatement Contractor Signature/Date: _____

Abatement Contractor Print Name: _____

ATTACHMENT #2

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME: _____ DATE: _____

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: _____

Printed Name: _____

Social Security Number: _____

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/CIH: _____ Date: _____

Printed Name of CPIH/CIH: _____

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 _____

- - END- - - -

**SECTION 02 82 13.31
ASBESTOS TRANSITE ABATEMENT**

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INSTRUCTIONS TO ARCHITECT/ENGINEER AND INDUSTRIAL HYGIENE CONSULTANT

**SECTION 02 82 13.31
ASBESTOS TRANSITE ABATEMENT SPECIFICATIONS**

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 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 Asbestos Abatement Contractor. All costs incurred.

1.1.2 EXTENT OF WORK

- A. Below is a brief description of the estimated quantities of asbestos transite materials to be abated. These quantities are for informational purposes only and are based on the best information available at the time of the specification preparation. The Contractor shall satisfy himself as the actual quantities to be abated. Nothing in this section may be interpreted as limiting the extent of work otherwise required by this contract and related documents.
- B. Removal, clean-up and disposal of ACM transite in an appropriate regulated area in the following approximate quantities;

(9) square feet of transite

1.1.3 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING.
- B. Section 02 41 00, DEMOLITION.
- C. Division 09, FINISHES.

1.1.4 TASKS

The work tasks are summarized briefly as follows:

- A. Pre-abatement activities including pre-abatement meeting(s), inspection(s), notifications, permits, submittal approvals, regulated area preparations, emergency procedures arrangements, and standard operating procedures for 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.

1.1.5 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 VA Design and Construction Procedure. VA Design and Construction Procedure 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 estimated which are limited by the physical constraints imposed by occupancy of the buildings and accessibility to ACM. 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 newly discovered ACM and those prices shall be used for additional work required under the contract.

1.3 STOP ASBESTOS REMOVAL

If the Contracting Officer; their field representative; (the facility Safety Officer/Manager or their designee, or the VA Professional Industrial Hygienist/Certified Industrial Hygienist (VPIH/CIH) presents a verbal **Stop Asbestos Removal Order**, the Contractor/Personnel shall immediately stop all asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM. If a verbal Stop Asbestos Removal Order is issued, the VA shall follow-up with a written order to the Contractor as soon as practicable. The Contractor shall not resume any asbestos removal activity until authorized to do so in writing by the VA Contracting Officer. A stop asbestos removal order may be issued at any time the VA Contracting Officer determines abatement conditions/activities are not within VA specification, regulatory requirements or that an imminent hazard exists to human health or the environment. 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 VPIH/CIH time. The occurrence of any of the following events shall be reported immediately by the Contractor's

competent person to the VA Contracting Office or field representative using the most expeditious means (e.g., verbal or telephonic), followed up with written notification to the Contracting Officer as soon as it is practical. The Contractor shall immediately stop asbestos removal/disturbance activities and initiate fiber reduction activities:

- A. Airborne PCM analysis results equal to or greater than 0.01 f/cc outside a regulated area or >0.05 f/cc inside a regulated area;
- B. breach or break in regulated area containment barrier(s);
- C. less than -0.02" WCG pressure in the regulated area;
- D. serious injury/death at the site ;
- E. fire/safety emergency at the site ;
- F. respiratory protection system failure;
- G. power failure or loss of wetting agent; or
- H. 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. Includes removal, encapsulation, enclosure, demolition and renovation activities related to asbestos containing materials (ACM).

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. For personal samples and clearance air testing using Phase Contrast Microscopy (PCM) analysis. NIOSH Method 7402 can be used when it is necessary to confirm fibers counted by PCM as being asbestos. The AHERA TEM analysis may be used for background, area samples and clearance samples when required by this specification, or at the discretion of the VPIH/CIH as appropriate.

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 Hazard Abatement Plan (AHAP) - Asbestos work procedures required to be submitted by the contractor before work begins.

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

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

Asbestos-contaminated soil (ACS) - Soil found in the work area or in adjacent areas such as crawlspaces or pipe tunnels which is contaminated with asbestos-containing material debris and cannot be easily separated from the material.

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

Asbestos Project Monitor - Some states require that any person conducting asbestos abatement clearance inspections and clearance air sampling be licensed as an asbestos project monitor.

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 representative having jurisdiction over the regulated area (e.g., OSHA, Federal and State EPA).

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 - Plastic barriers placed over critical barriers and exposed directly to abatement work.

Secondary Barrier - Any additional plastic barriers 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) - A person certified in the comprehensive practice of industrial hygiene 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 professional industrial hygiene consultant/Certified Industrial Hygienist (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/CIH) - The asbestos abatement contractor's industrial hygienist. The industrial hygienist must meet the qualification requirements of a PIH and may be a certified industrial hygienist (CIH).

Count - Refers to the fiber count or the average number of fibers greater than five microns in length with a length-to-width (aspect) ratio of at least 3 to 1, per cubic centimeter of air.

Crawlspace - An area which can be found either in or adjacent to the work area. This area has limited access and egress and may contain asbestos materials and/or asbestos contaminated soil.

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.

VA Total - means a building or substantial part of the building is completely removed, torn or knocked down, bulldozed, flattened, or razed, including removal of building debris.

Disposal bag - Typically 6 mil thick sift-proof, dustproof, leak-tight 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 sift-proof, dustproof, and leak-tight.

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 (aspect) 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 one (1) percent or 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 - An ASHRAE MERV 17 filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers 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 (IH) - 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 (IH 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. Some states require that an industrial hygienist technician conducting asbestos abatement clearance inspection and clearance air sampling be licensed as an asbestos project monitor.

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) - EPA's rule to control emissions of asbestos to the environment (40 CFR part 61, Subpart M).

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 column 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 pressure outside the respirator facepiece.

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 to remove organic vapor hazardous air contaminants.

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 protective equipment (PPE) - equipment designed to protect user from injury and/or specific job hazard. Such equipment may include protective clothing, hard hats, safety glasses, and respirators.

Personal sampling/monitoring - Representative air samples obtained in the breathing zone for one or workers within the regulated area using a filter cassette and a calibrated air sampling 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 eight (8) hour time weighted average PEL is 0.1 fibers per cubic centimeter (0.1 f/cc) of air and the 30-minute Excursion Limit is 1.0 fibers per cubic centimeter (1 f/cc).

Pipe tunnel - An area, typically located adjacent to mechanical spaces or boiler rooms in which the pipes servicing the heating system in the building are routed to allow the pipes to access heating elements. These areas may contain asbestos pipe insulation, asbestos fittings, or asbestos-contaminated soil.

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, flame retardant per NFPA 241.

Positive/negative fit check - A method of verifying the seal of a facepiece respirator by temporarily occluding the filters and breathing in (inhaling) and then temporarily occluding the exhalation valve and

breathing out (exhaling) while checking for inward or outward leakage of the respirator respectively.

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 (b).

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. The PIH may be either the VA's PIH (VPIH) or Contractor's PIH (CPIH/CIH).

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).

Assigned Protection factor - A value assigned by OSHA/NIOSH to indicate the expected protection by each respirator class, when the respirator is properly selected and worn correctly. The number indicates the reduction of exposure level from outside to inside the respirator facepiece.

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 non-friable ACM that has become friable; Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading or; Category II non-friable 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.

Supplied air respirator (SAR) - A respiratory protection system that supplies minimum Grade D respirable air per ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989.

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 Professional Industrial Hygienist (VPIH/CIH) - The Department of Veterans Affairs Professional Industrial Hygienist must meet the qualifications of a PIH, and may be a Certified Industrial Hygienist (CIH).

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/ACS or ACM waste material.

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

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

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

- F. CS Commercial Standard of the National Institute of Standards and Technology (NIST)
U. S. Department of Commerce
Government Printing Office
Washington, DC 20420

- G. EPA Environmental Protection Agency
401 M St., SW
Washington, DC 20460
202-382-3949

- H. MIL-STD Military Standards/Standardization Division
Office of the Assistant Secretary of Defense
Washington, DC 20420

- J. NIST National Institute for Standards and Technology
U. S. Department of Commerce
Gaithersburg, MD 20234
301-921-1000

- K. NEC National Electrical Code (by NFPA)

- L. NEMA National Electrical Manufacturer's Association
2101 L Street, NW
Washington, DC 20037

- M. NFPA National Fire Protection Association
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
800-344-3555

- N. NIOSH National Institutes for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, OH 45226
513-533-8236

- O. OSHA Occupational Safety and Health Administration
U.S. Department of Labor
Government Printing Office
Washington, DC 20402

- P. UL Underwriters Laboratory
333 Pfingsten Rd.
Northbrook, IL 60062
312-272-8800

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 specifications 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 Asbestos Abatement Contractor (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 asbestos abatement project. The Contractor is responsible for providing and maintaining training, accreditations, medical exams, medical records, personal protective equipment (PPE) including respiratory protection including respirator fit testing, as required by applicable Federal, State and Local regulations. The Contractor shall hold the VA and VPIH/CIH consultants harmless for any Contractor's 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/CIH, including all sampling/analytical costs to assure compliance with OSHA/EPA/State requirements related to failure to comply with the regulations applicable to the work.

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 Subpart I - Personal Protective Equipment
 - 3. Title 29 CFR 1910.134 - Respiratory Protection
 - 4. Title 29 CFR 1926 - Construction Industry Standards
 - 5. Title 29 CFR 1910.1020 - Access to Employee Exposure and Medical Records
 - 6. Title 29 CFR 1910.1020 - Hazard Communication
 - 7. Title 29 CFR 1910 Subpart K - 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 STATE REQUIREMENTS

State requirements that apply to the asbestos abatement work, disposal, clearance, etc., include, but are not limited to, the following:

- A. Asbestos Bureau Control
 - 1. Industrial Code Rule 56 (12 NYCRR Part 56)

1.5.5 NOT USED.**1.5.6 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

1.5.7 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

1.5.8 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 as notification is given to EPA, State, and Local authorities.

1.5.9 PERMITS/LICENSES

- A. 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.

1.5.10 POSTING AND FILING OF REGULATIONS

- A. 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.

1.5.11 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, calibration data and method of analysis. 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.

1.5.13 EMERGENCY ACTION PLAN AND ARRANGEMENTS

- A. An Emergency Action Plan shall be developed by 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 in the clean room and equipment room of the decontamination unit. 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; layout of regulated area; and access to the 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 any/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 3-4 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; power failure; negative pressure failure; and supplied air system failure. The Contractor shall detail procedures to be followed in the event of an incident assuring that asbestos abatement work is stopped and wetting is continued until correction of the problem..

1.5.14 PRE-CONSTRUCTION MEETING

Prior to commencing the work, the Contractor shall meet with the VA Certified Industrial Hygienist (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(s) is trained and accredited and approved for working in this State. Verification of the experience of the Competent Person(s) 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 Asbestos Hazard Abatement Plan. 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. Decontamination area set-up/layout and decontamination procedures for employees;
 - 4. Abatement methods/procedures and equipment to be used; and
 - 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(s) 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 color 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 federal (and state as applicable) EPA and OSHA asbestos regulations in the past three (3) years; has adequate liability/occurrence insurance for asbestos work as required by the state; 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 within the past three (3) years; 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/CIH (CPIH/CIH) 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 or equivalent, 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 within the past three (3) years of similar size and complexity; has applicable medical and respiratory protection documentation; has certificate of training/current refresher and State accreditation/license.

All personnel should be in compliance with OSHA construction safety training as applicable and submit certification.

1.7 RESPIRATORY PROTECTION

1.7.1 GENERAL - RESPIRATORY PROTECTION PROGRAM

The Contractor shall develop and implement a written 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.Subpart I;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 RPP 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 RPP of similar size and complexity. The RPPC must submit 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 qualifications. 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 half face, HEPA filtered, air purifying respirator when fiber levels are maintained consistently at or below 0.1 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 or other licensed health care professional has provided a written determination they are medically qualified to wear the class of respirator to be used on the project while wearing whole body impermeable garments and subjected to heat or cold stress.

1.7.6 RESPIRATOR FIT TEST

All personnel wearing respirators shall have a current qualitative/quantitative fit test which was conducted in accordance with 29 CFR 1910.134 (f) and Appendix A. Quantitative fit tests shall be done for PAPRs which have been put into a motor/blower failure mode.

1.7.7 RESPIRATOR FIT CHECK

The Competent Person shall assure that the positive/negative pressure user seal check is done each time the respirator is donned by an employee. Head coverings must cover respirator head straps. Any situation that prevents an effective facepiece to face seal as evidenced by failure of a user seal check shall preclude that person from wearing a respirator inside the regulated area 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. A current physician's written opinion as required by 29 CFR 1926.1101 (m)(4) shall be provided for each person and shall include in the medical opinion the person has been evaluated for working in a heat and cold stress environment while wearing personal protective equipment (PPE) and is able to perform the work without risk of material health impairment.

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. Worker protection shall meet the most stringent requirements.

1.8.4 REGULATED AREA ENTRY PROCEDURE

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

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 all disposable PPE and dispose of in a disposal bag provided in the regulated area.
- B. Carefully decontaminate and clean the respirator. Put in a clean container/bag.

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 regulated areas at 29 CFR 1926.1101 (e) are met applicable to Class II work. 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 a fiber drum with a disposal bag in it for personnel waste materials.

SPEC. WRITER NOTE: OSHA does not require a decontamination unit for Class II work.

1.9.2 WASTE/EQUIPMENT DECONTAMINATION AREA (W/EDA)

The Competent Person shall provide a W/EDA for removal of all waste, equipment and contaminated material from the regulated area.

1.9.3 WASTE/EQUIPMENT DECONTAMINATION PROCEDURES

Contain all waste in 6 mil poly bags. Clean/decontaminate bags and pass through a double 6 mil flap doorway into another bag or fiber drum. Remove to disposal dumpster/gondola/vehicle. At no time shall unprotected personnel from the clean side be allowed to enter the regulated area.

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/CIH has submitted verification to the VA's representative.

- 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 and combustible materials cannot be stored inside buildings. Replacement materials shall be stored outside of the regulated 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 location.
- 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. Polyethylene sheeting for walls in the regulated area shall be a minimum of 4-mils. For floors and all other uses, sheeting of at least 6-mils shall be used in widths selected to minimize the frequency of joints. Fire retardant poly shall be used throughout.
- F. 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. Method of attachment may include any combination of moisture resistant duct tape furring strips, spray glue, staples, nails, screws, lumber and plywood for enclosures or other effective procedures capable of sealing polyethylene to dissimilar finished or unfinished surfaces under both wet and dry conditions.
- G. Polyethylene sheeting utilized for the PDF 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, 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. All electrically operated hand tools, equipment, electric cords shall be connected to 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 - Materials shall be wrapped in 2 layers of 6 mil poly for transite waste and shall be pre-printed with labels, markings and address as required by OSHA, EPA and DOT regulations. If necessary, materials may be boxed or otherwise packaged to prevent damage to transite waste materials during transport. If boxed or otherwise packaged, appropriate labels shall be affixed to the outer layer of the final container.
- L. The VA shall be provided an advance copy of the MSDS as required for all hazardous chemicals under OSHA 29 CFR 1910.1200 - Hazard Communication in the pre-project submittal. Chlorinated compounds shall not be used with any spray adhesive, mastic remover 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 written hazard assessment conducted under 29 CFR 1910.132(d).

2.2 CONTAINMENT BARRIERS AND COVERINGS IN THE REGULATED AREA

2.2.1 GENERAL

- A. Using critical barriers, Seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent spaces. All surfaces in the regulated area must be covered to prevent contamination and to facilitate clean-up. Should adjacent areas become contaminated as a result of the work, shall immediately stop work and clean up the contamination at no additional cost to the VA. Provide firestopping and identify all fire barrier penetrations due to abatement work as specified in Section 3.1.4.8; FIRESTOPPING.
- B. Place all tools, scaffolding, materials and equipment needed for working in the regulated area prior to erecting any plastic sheeting. All uncontaminated removable furniture, equipment and/or supplies shall be removed by the VA from the regulated area before commencing work. Any objects remaining in the regulated area shall be completely covered with 2 layers of 6-mil fire retardant poly sheeting and secured with duct tape. Lock out and tag out any HVAC/electrical systems in the regulated area.

2.2.3 CONTROLLING ACCESS TO THE REGULATED AREA

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

Completely separate any operations in the regulated area from adjacent areas using 2 layers of 6 mil fire retardant poly 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/openings in the regulated area. Heat must be shut off any objects covered with poly.

2.2.5 SECONDARY BARRIERS:

A loose layer of 6 mil poly shall be used as a drop cloth to protect the primary layers from debris generated during the abatement. This layer shall be replaced as needed during the work and at a minimum once per work day.

2.2.6 EXTENSION OF THE REGULATED AREA

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. 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, conduits, etc. 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. OSHA requires that the employee exposure to asbestos must not exceed 0.1 fibers per cubic centimeter (f/cc) of air, averaged over an 8-hour work shift. The CPIH/CIH is responsible for and shall 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/CIH 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/CIH with review and approval of the VPIH/CIH. An agreement between the CPIH/CIH 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; adherence to the specification; resolve problems; prevent the spread of contamination beyond the regulated area; and assure clearance at the end of the project. 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. The VPIH/CIH will perform the following tasks:
1. Task 1: Establish background levels before abatement begins by collecting background samples. Retain samples for possible TEM analysis.
 2. Task 2: Perform continuous air monitoring, inspection, and testing outside the regulated area during actual abatement work to detect any faults in the regulated area isolation and any adverse impact on the surroundings from regulated area activities.
 3. Task 3: Perform unannounced visits to spot check overall compliance of work with contract/specifications. These visits may include any inspection, monitoring, and testing inside and outside the regulated area and all aspects of the operation except personnel monitoring.
 4. Task 4: Provide support to the VA representative such as evaluation of submittals from the Contractor, resolution of conflicts, interpret data, etc.
 5. Task 5: Perform, in the presence of the VA representative, final inspection and testing of a decontaminated regulated area at the conclusion of the abatement to certify compliance with all regulations and VA requirements/specifications.
 6. Task 6: Issue certificate of decontamination for each regulated area and project report.
- B. All documentation, 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.
- D. All air sampling and analysis data will be recorded on VA Form 10-0018.

2.3.3 MONITORING, INSPECTION AND TESTING BY CONTRACTOR CPIH/CIH

The Contractor's CPIH/CIH 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/CIH 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 sampling and analysis. The IH Technician shall have successfully completed a NIOSH 582 Course or equivalent and provide documentation. 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 AHERA/State Contractor/Supervisor, Abatement Worker and Building Inspector. The IH Technician shall have participated in five abatement projects collecting personal and area samples as well as responsibility for documentation on substantially similar projects in size and scope. The analytic laboratory used by the Contractor to analyze the samples shall be AIHA accredited for asbestos PAT and approved by the VA prior to start of the project. A daily log, shall be maintained by the CPIH/CIH or IH Technician, documenting all OSHA requirements for air personal 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 upon request. The log will contain, at a minimum, information on personnel or area samples, 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/CIH 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/CIH will perform inspection and testing at the final stages of abatement for each regulated area as specified in the CPIH/CIH responsibilities. Additionally, the CPIH/CIH will monitor and record pressure readings within the containment daily with a minimum of two readings at the beginning and at the end of a shift, and submit the data in the daily report.

2.4 ASBESTOS HAZARD ABATEMENT PLAN

The Contractor shall have established Asbestos Hazard Abatement Plan (AHAP) 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 AHAP(s) must be modified as needed to address specific requirements of the project. The AHAP 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 AHAP(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 Class II work

- G. Decontamination Facilities and Entry/Exit Procedures (PDF and W/EDF)
- H. Monitoring, Inspections, and Testing
- I. Removal Procedures for Class II Materials
- 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-START 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 Asbestos Hazard Abatement Plan developed specifically for this project, incorporating the requirements of the specifications, prepared, signed and dated by the CPIH/CIH.
- D. Submit the specifics of the materials and equipment to be used for this project with manufacturer names, model numbers, performance characteristics, pictures/diagrams, and number available for the following:
 1. Supplied air system, negative air machines, HEPA vacuums, air monitoring pumps, calibration devices, pressure differential monitoring device and emergency power generating system.
 2. Waste water filtration system, shower system, containment barriers.
 3. Encapsulants, surfactants, hand held sprayers, airless sprayers, and fire extinguishers.
 4. Respirators, protective clothing, 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. Personal air monitoring must be done in accordance with OSHA 29 CFR 1926.1101(f) and Appendix A. Area or clearance air monitoring shall be conducted in accordance with EPA AHERA protocols.
- 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; and 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 (e.g., OSHA), notices of violations (e.g., Federal and state EPA), penalties, and legal actions taken against the company including and of the company's officers (including damages paid) 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; copies of certificates, accreditations, and licenses. Submit an affidavit signed by the CPIH/CIH 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 written respiratory protection program, and maintains recordkeeping in accordance with the above regulations. Submit the phone number and doctor/clinic/hospital used for medical evaluations.
1. CPIH/CIH and IH Technician: 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 AHAP(s) developed; medical opinion; and 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 in size/complexity 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 (asbestos surveillance and respirator use); and 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 (asbestos surveillance and respirator use); and 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 language 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 performs and how is personal air monitoring of abatement workers 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. Rented equipment must be decontaminated prior to returning to the rental agency.
- L. Submit, before the start of work, the manufacturer's technical data for all types of encapsulants, all MSDS and application instructions.

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 barrier breeching, equipment failures, emergencies, and any cause for stopping work; representative air monitoring and results/TWAs/ELs. Submit this information daily to the VPIH/CIH.
- B. The CPIH/CIH shall document and maintain the inspection and approval of the regulated area preparation prior to start of work and daily during work.
 - 1. Removal of any poly barriers.
 - 2. Visual inspection/testing by the CPIH/CIH or IH Technician prior to application of lockdown encapsulant.
 - 3. Packaging and removal of ACM waste from regulated area.
 - 4. 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/CIH 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. It will also include information on the containment and transportation of waste from the containment with applicable Chain of Custody forms. The report shall include a certificate of completion, signed and dated by the CPIH/CIH, in accordance with Attachment #1. All clearance and perimeter area samples must be submitted. The VA Representative will retain the abatement report after completion of the project and provide copies of the abatement report to VAMC Office of Engineer and the Safety Office.

PART 3 - EXECUTION

3.1 REGULATED AREA PREPARATIONS

3.1.1 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 of a critical barrier doorway. 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 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 Representative or Competent Person. The VA Police should be informed of asbestos abatement regulated areas to provide security checks during facility rounds and emergency response.

3.1.2 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 the PEL. 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.

3.1.3 SHUT DOWN - LOCK OUT ELECTRICAL

Shut down and lock out/tag out electric power to the regulated area. Provide temporary power and lighting. Insure 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.

3.1.4 SHUT DOWN - LOCK OUT HVAC

Shut down and lock out/tag 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.

3.1.5 NEGATIVE PRESSURE FILTRATION SYSTEM

The Contractor shall provide enough HEPA negative air machines to effect greater than (>) - 0.02" water column gauge (WCG) pressure. The Competent Person shall determine the number of units needed for the regulated area by dividing the cubic feet in the regulated area by 15 and then dividing that result by the cubic feet per minute (CFM) for each unit to determine the number of units needed to effect > - 0.02" WCG pressure. Provide a standby unit in the event of machine failure and/or emergency in an adjacent area.

NIOSH has done extensive studies and has determined that negative air machines typically operate at ~50% efficiency. The contractor shall consider this in their determination of number of units needed to provide > - 0.02" WCG pressure. The contractor shall use double the number of machines, based on their calculations, or submit proof their machines operate at stated capacities, at a 2" pressure drop across the filters.

3.1.6 CONTAINMENT BARRIERS AND COVERINGS FOR THE REGULATED AREA

3.1.6.1 GENERAL

- A. Using critical barriers, seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent spaces. All surfaces in the regulated area must be covered to prevent contamination and to facilitate clean-up. Should adjacent areas become contaminated as a result of the work, shall immediately stop work and clean up the contamination at no additional cost to the VA. Provide firestopping and identify all fire barrier penetrations due to abatement work as specified in Section 3.1.4.8; FIRESTOPPING.

3.1.6.2 PREPARATION PRIOR TO SEALING OFF

Place all tools, scaffolding, materials and equipment needed for working in the regulated area prior to erecting any plastic sheeting. All uncontaminated removable furniture, equipment and/or supplies shall be removed by the VA from the regulated area before commencing work. Any objects remaining in the regulated area shall be completely covered with 2 layers of 6-mil fire retardant poly sheeting and secured with duct tape. Lock out and tag out any HVAC/electrical systems in the regulated area.

3.1.6.3 CONTROLLING ACCESS TO THE REGULATED AREA

Access to the regulated area shall be permitted only by the competent person. 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 to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid and capable of withstanding the negative pressure.

3.1.6.4 CRITICAL BARRIERS

Completely separate any operations in the regulated area from adjacent areas using 2 layers of 6 mil fire retardant poly 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/openings in the regulated area. Heat must be shut off any objects covered with poly.

3.1.6.5 EXTENSION OF THE REGULATED AREA

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.

Decontamination measures must be started immediately and continue until air monitoring indicates background levels are met

3.1.6.6 FLOOR BARRIERS

If floor removal is not being done, all floors in the regulated area shall be covered with 2 layers of 6 mil fire retardant poly and brought up the wall 12 inches.

3.1.7 PERSONAL PROTECTIVE EQUIPMENT

Refer to Sections 1,7 and 1.8.3 of this document.

3.1.8 SANITARY FACILITIES

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

3.1.9 PRE-CLEANING

3.1.9.1 PRE-CLEANING MOVABLE OBJECTS

Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area. After items have been pre-cleaned and decontaminated, they may be removed from the work area for storage until the completion of abatement in the work area.

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.

3.1.9.2 PRE-CLEANING FIXED OBJECTS

Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area

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 pre-cleaning, 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.

3.1.9.3 PRE-CLEANING SURFACES IN THE REGULATED AREA

Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work 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.

3.1.10 PRE-ABATEMENT ACTIVITIES

3.1.10.1 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.

3.1.10.2 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 VA A/E Quality Alert 07/09 indicating the failure to identify asbestos in the areas listed as well as common issues when preparing specifications and contract documents. This is especially critical when demolition is planned, because AHERA surveys are non-destructive, and ACM may remain undetected. A NESHAP-compliant (destructive) ACM inspection should be conducted on all building structures that will be demolished. Ensure the following areas are inspected on the project: Lay-in ceilings concealing ACM; ACM behind walls/windows from previous renovations; inside utility chases/walls; transite piping/ductwork/sheets; behind radiators; lab fume hoods; transite lab countertops; roofing materials; below window sills; water/sewer lines; electrical conduit coverings; crawl spaces(previous abatement contamination); flooring/mastic covered by carpeting/new flooring; exterior insulated wall panels; on underground fuel tanks; steam line trench coverings.
- C. Ensure that all furniture, machinery, equipment, curtains, drapes, blinds, and other movable objects required to be removed 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 and critical openings in the regulated area. The

regulated area critical barriers shall be completely isolate the regulated area 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.

3.1.10.3 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/CIH 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 AHAP(s), especially worker protection, respiratory systems, contingency plans, decontamination procedures, and monitoring to demonstrate satisfactory operation. The operational systems for respiratory protection and the negative pressure system shall be demonstrated for proper performance.
- C. The CPIH/CIH 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 and all applicable regulations.

3.2 REMOVAL OF CLASS II TRANSITE MATERIALS

3.2.1 GENERAL

All applicable requirements of OSHA, EPA, and DOT shall be followed during Class II work. Keep materials intact; do not break up materials; wet while working with it; wrap as soon as possible with 2 layers of 6 mil plastic for disposal, and maintain good housekeeping in work areas during abatement.

3.2.2 OUTDOOR WORK AREAS

On some projects, work must be performed on exterior areas of the building. If outdoor work is to be performed, all applicable OSHA, state and local regulations must be followed to ensure that outdoor

work areas are in compliance so that workers, the general public and the environment are protected.

3.2.3 SCAFFOLD FALL PROTECTION

Each employee more than 6 feet above the base work level shall be protected from falls by guardrails or a fall arrest system. Fall arrest system includes harnesses, components of the harness/belt such as Dee-rings, and snap hooks, lifelines, and anchorage points. Lifelines must be independent of supports lines and suspension ropes and not attached to the same anchorage point as the support or suspension rope. OSHA's scaffolding standard defines a competent person as "one who is capable of identifying existing and predictable hazards in the surroundings or working conditions, which are unsanitary, hazardous to employees, and who has authorization to take prompt corrective measures to eliminate them." The competent person will determine if it is safe for employees to work on or from a scaffold or roof during storms or high winds and to ensure that a personal fall arrest system will protect the employees. The competent person will also inspect the scaffold and scaffold components for visible defects before each work shift and after any occurrence which could affect the structural integrity and to authorize prompt corrective measures.

3.2.4 ROOF/ELEVATED WORK AREA PROTECTION

The competent person shall determine if the walking/working surfaces on which the employees are to work on have the strength and structural integrity to support the employees safely. Each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is 6 feet or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest system.

3.2.5 EXCAVATION/TRENCHING WORK AREA PROTECTION

Each employee who is working in excavation/trenching work areas to alter or remove materials such as underground piping shall be protected from hazards arising from such work areas. A competent person who is OSHA trained in excavation/trenching operations must be present on site at all time in which work in these areas occurs. The competent person will determine if it is safe for employees to work on or in excavation/trenching work areas and to ensure that all applicable safety measures will protect the employees. The competent person will also inspect the excavation/trenching areas for visible defects before each work shift and after any occurrence which could affect the structural integrity of the excavation/trenching areas and to authorize prompt corrective measures.

3.2.6 REMOVAL OF TRANSITE:

- A. All transite must be wetted prior to removal. Unfasten transite panels without disturbance. Keep transite intact.
- B. All waste must be wrapped in two layers of 6 mil poly and lowered carefully to the ground.
- C. Materials may not be dropped from any height. Unless the material is carried or passed to the ground by hand, it shall be lowered to the ground via covered, dust-tight chute, crane or hoist.

3.3 DISPOSAL OF CLASS II WASTE MATERIAL

3.3.1 GENERAL

The VA must be notified at least 24 hours in advance of any waste removed from the containment. 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. Transport will be in compliance with 49 CFR 100-185 regulations. Disposal shall be done at an approved landfill. Disposal of non-friable ACM shall be done in accordance with applicable regulations.

3.4 PROJECT DECONTAMINATION

3.4.1 GENERAL

- A. The entire work related to project decontamination shall be performed under the close supervision and monitoring of the CPIH/CIH.
- 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 cleanings of the surfaces of the regulated area 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.

3.4.2 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.

3.4.3 WORK DESCRIPTION

Decontamination includes the clearance air testing 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, and negative pressure systems.

3.4.4 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 removal 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.
 2. Decontamination facilities, if required for personnel and equipment in operating condition.

3.4.5. 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/air blowing methods. Use each surface of a wetted 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. Remove all filters in the air handling system and dispose of as ACM waste in accordance with these specifications. The negative pressure system shall remain in operation during this time. Additional cleaning(s) may be needed as determined by the CPIH/VPIH/CIH.

3.5 VISUAL INSPECTION AND AIR CLEARANCE TESTING

3.5.1 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 cleaning.

3.5.2 VISUAL INSPECTION

Final visual inspection will include the entire regulated area, 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 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.

3.5.3 AIR CLEARANCE TESTING

- A. After an acceptable final visual inspection by the VPIH/CIH and VA Representative, the VPIH/CIH will perform the final clearance testing. Air samples will be collected and analyzed in accordance with procedures for AHERA in this specification. If work is less than 260 lf/160 sf/35 cf, 5 PCM samples shall be collected for clearance and a minimum of one field blank. If work is equal to or more than 260 lf/160 sf/35 cf, AHERA TEM sampling shall be performed for clearance. TEM analysis shall be done in accordance with procedures for EPA AHERA in this specification. If the release criteria are not met, the Contractor shall repeat the final cleaning and continue decontamination procedures until clearance is achieved. **All Additional inspection and testing costs will be borne by the Contractor.**
- B. If release criteria are met, proceed to perform the abatement closeout and to issue the certificate of completion in accordance with these specifications.

3.5.4 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 by PCM 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.

2. All final air testing samples shall be collected using aggressive sampling techniques except where soil is not encapsulated or enclosed. Samples will be collected on 0.8 μ MCE filters for PCM analysis and 0.45 μ Polycarbonate filters for TEM. A minimum of 1200 Liters of using calibrated pumps shall be collected for clearance samples. Before pumps are started, initiate aggressive air mixing 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. The negative pressure system shall continue to operate.

3.6 ABATEMENT CLOSEOUT AND CERTIFICATE OF COMPLIANCE

3.6.1 COMPLETION OF ABATEMENT WORK

- A. After thorough decontamination, complete asbestos abatement work upon meeting the regulated area clearance criteria and fulfilling the following:
 1. Remove all equipment, materials, and debris from the project area.
 2. Package and dispose of all asbestos waste as required.
 3. Repair or replace all interior finishes damaged during the abatement work.
 4. Fulfill other project closeout requirements as specified elsewhere in this specification.

3.6.2 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.

3.6.3 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. Workers will be provided with adequate washing and break area facilities located away from the containment site.

ATTACHMENT #1

CERTIFICATE OF COMPLETION

DATE: _____ VA Project #: _____

PROJECT NAME: _____ Abatement Contractor: _____

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 abatement work was done in accordance with OSHA requirements and the manufacturer's recommendations.

CPIH/CIH Signature/Date: _____

CPIH/CIH Print Name: _____

Abatement Contractor Signature/Date: _____

Abatement Contractor Print Name: _____

ATTACHMENT #2**CERTIFICATE OF WORKER'S ACKNOWLEDGMENT**

PROJECT NAME: _____ DATE: _____

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: _____

Printed Name: _____

Social Security Number: _____

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/CIH: _____ Date: _____

Printed Name of CPIH/CIH: _____

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 _____

- - END- - - -

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

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including general and supplementary conditions and Division 1 specification sections, apply to this section.
- B. Concrete paving and walks are specified in Division 31.
- C. Waterproofing is specified in Division 7.

1.2 DESCRIPTION OF WORK

- A. This section specifies cast-in-place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

1.3 QUALITY ASSURANCE

A. Reference Standards:

- 1. ACI 211.1 "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete."
- 2. ACI 301 "Specifications for Structural Concrete for Buildings."
- 3. ACI 303 "Guide to Cast-in-Place Architectural Concrete Practice."
- 4. ACI 304 "Guide for Measuring, Mixing, Transporting, and Placing Concrete."
- 5. ACI 305 "Hot-Weather Concreting."
- 6. ACI 306 "Cold-Weather Concreting."
- 7. ACI 311 "Guide for Concrete Inspection" and "Batch Plant Inspection and Field Testing of Ready-Mixed Concrete."
- 8. ACI 315 "Details and Detailing of Concrete Reinforcement."
- 9. ACI 318 "Building Code Requirements for Structural Concrete."
- 10. ACI 347 "Guide to Formwork for Concrete."
- 11. ACI SP-15 "Field Reference Manual." A copy of this publication shall be kept in the field office at all times during concrete construction.
- 12. AWS "Structural Welding Code - Reinforcing Steel."
- 13. CRSI "Manual of Standard Practice."
- 14. NYSDOT "Standard Specification for Construction and Materials."

- B. To minimize irregularities in appearance or color, obtain cement, aggregates, admixtures, and water for each type of concrete construction exposed to view in completed project from same source for duration of that type of construction.

1.4 SPECIAL INSPECTIONS

- A. Refer to Specification Section 01 45 29 and Schedule of Special Inspections.

1.5 MATERIAL EVALUATION/QUALITY CONTROL

- A. Preconstruction Testing: Contractor shall employ Testing Agency acceptable to Engineer and Architect to perform material evaluation tests and evaluate concrete mixes prior to submitting.
- B. Submit concrete testing service qualifications demonstrating experience with similar projects.
- C. Require concrete supplier to provide delivery tickets for each truckload of concrete. Tickets shall be presented to and reviewed by Contractor and Special Inspector or Testing Agency prior to discharging concrete into structure.
 - 1. Tickets shall contain project identification name, name of Contractor, name of concrete supplier, location of batch plant, date and time of concrete batching, truck number, delivery ticket number, concrete type and class, concrete mix number, design compressive strength at 28 days, concrete mix proportions and materials, and amount of total mix design water that can be added at site prior to discharging into structure if total mix design water was not used when batched. See Part 3 of this section for maximum water amount that can be added at site.
- D. The Registered Design Professionals (RDPs) for Structural Engineering and Architecture and the Special Inspector will visit construction site at appropriate intervals to determine if work is in general conformance with Contract Documents and specifications. Notify RDPs 48 hours before anticipated time of completion of reinforcement for a given section of work so they may determine if site observations are required. If site observations are required, do not place concrete until RDPs have had opportunity to observe reinforcement.

1.6 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Show bar schedules, bar spacing, diagrams of bent bars, and arrangements of concrete reinforcement. Include special reinforcement required for openings through concrete.
 - a. Show elevations of reinforcement for all members at minimum 1/4 inch = 1 foot scale.
 - b. Show locations of construction and control joints.
 - c. Reference Contract Drawing number and addendum number in each shop drawing.
 - d. Do not place reinforcing information from more than one design discipline (structural, civil, landscape) in each drawing.
- B. Mix Designs: Submit proposed mix designs for concrete 15 days minimum before start of concreting. Submittal must be in the Concrete Mix Design Submittal Form at end of this section for each class of concrete.
- C. Submit data and installation instructions for proprietary material.
- D. Submit to Special Inspector and Engineer material certificates certifying each material complies with specifications.

- E. Submit chloride ion content of proposed admixtures prior to submitting mix design.

1.7 PRODUCT HANDLING

- A. Store materials so as to preserve their quality and fitness for work. Store reinforcement and formwork in manner to prevent damage and accumulation of dirt.

1.8 WORKMANSHIP

- A. Contractor shall be responsible for correction of concrete work not conforming to specified requirements, including strength, tolerances, and finishes. Correct deficient concrete as directed by Architect.
- B. Remove work found to be defective. Replace with new acceptable work.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed/plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown in drawings. Plywood materials shall be one of the following:
 1. Overlaid plywood complying with U.S. Product Standards PS-1 "A-C or B-B High Density Overlaid (HDO) Concrete Form," Class 1, exterior grade or better.
 2. Plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class 1, exterior grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
- B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Form Coatings: Provide commercial formulation form-coating compounds with maximum VOC of 450 g/l that will not bond with, stain, or adversely affect concrete surfaces or impair subsequent treatments of concrete surfaces requiring bond or adhesion or impede wetting of surfaces to be cured with water or curing compound.
- D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off, metal form ties, designed to prevent form deflection and spalling concrete upon removal. Provide units that will leave no metal closer than 1 inch to exposed surface.
 1. Provide ties that will leave holes no larger than 1-inch diameter in concrete surface when removed.
 2. Unexposed concrete: "Type A-3 Snap Tie Standard" by Dayton Superior or accepted equivalent.
 3. Exposed concrete: "Type A-3 Snap Tie Heavy" by Dayton Superior or accepted equivalent.
 4. Provide galvanized or stainless steel ties for concrete elements that are reinforced with epoxy-coated or galvanized reinforcing.
 5. Internal wood spreaders are prohibited.

2.2 REINFORCING MATERIALS

- A. Deformed bars: ASTM A 615, Grade 60. Deformed bars to be welded, ASTM A 706.
- B. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars in place. Use wire bar-type or all plastic-type supports complying with CRSI specifications. Use chairs with sand plates or horizontal runners where base material will not support chair legs.
 - 1. Concrete bricks may be used to support footing reinforcing. Stagger brick locations.
 - a. Do not use clay bricks.
 - b. Do not use bricks to support epoxy-coated or galvanized reinforcing.
 - 2. Finish for supports formed from reinforcing bars shall match the finish of the supported reinforcing.
 - 3. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are plastic-protected (CRSI, Class 1) or stainless-steel protected (CRSI, Class 2).
- D. Minimum 16-gauge annealed tie wire, ASTM A 82.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II.
- B. Aggregates: NYSDOT-approved, Section 703-02 (normal weight), one source and as specified.
 - 1. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps, or other deleterious substances.
 - 2. Coarse Aggregate: Clean, uncoated, processed aggregate free from clay, mud, loam, or foreign matter.
 - a. For footings, foundation walls, or mat foundations, blend of NYSDOT size 1 and 2 (25 percent size 1 and 75 percent size 2) or gradation conforming to ASTM C 33, size 467:

Sieve Size	Percent Passing
2 inch	100
1 1/2 inch	95 to 100
3/4 inch	35 to 70
3/8 inch	10 to 30
No. 4	0 to 5

- b. For other applications, blend of NYSDOT Size 1 and 2 (40 percent size 1 and 60 percent size 2) or gradation conforming to ASTM C 33, size 57:

Sieve Size	Percent Passing
1 1/2 inch	100
1 inch	95 to 100
1/2 inch	25 to 60
No. 4	0 to 10
No. 8	0 to 5

- c. No size requirement for stair-pan fill and lean concrete.

C. Water: Clean, fresh, drinkable.

D. Air Entraining: ASTM C 260.

E. Water-Reducing Admixture: "Eucon WR-75" or "WR-89" by Euclid Chemical Co.; "Pozzolith 220N" by Master Builders; or "Plastocrete 161" by Sika Chemical Corp. Admixture shall conform to ASTM C 494, Type A, and not contain more chloride ions than in municipal drinking water.

F. Water-Reducing Retarder: "Eucon Retarder-75" by Euclid Chemical Co.; "Pozzolith 100XR" by Master Builders; or "Plastiment" by Sika Chemical Corp. Admixture shall conform to ASTM C 494, Type D, and not contain more chloride ions than in municipal drinking water.

G. Noncorrosive, Nonchloride Accelerator: ASTM C 494, Type E, and not contain more chloride ions than in municipal drinking water.

H. Fly Ash: ASTM C 618, Type F, with a loss on ignition of less than 4 percent.

I. Ground-Granulated, Blast-Furnace Slag: ASTM C 989, Grade 120.

J. High-Range, Water-Reducing Admixture (Superplasticizer): "Eucon 37" by Euclid Chemical Co. or "Sikament" by Sika Chemical Corp. Admixture shall conform to ASTM C 494, Type F or G, and not contain more chloride ions than in municipal drinking water.

K. Nonchloride Waterproofing Admixture: "KIM -Krystol Internal Membrane", by Kryton International Inc. "Xypex Admix C-500, C-1000, or C-2000" by Xypex Chemical Corporation, or "Anti-Hydro - NC or NCR Waterproof Concrete" by Anti-Hydro International, Inc.

L. Prohibited Admixtures: Calcium chloride, thiocyanates, and admixtures containing more than 0.05 percent water-soluble chloride ions by weight of cement or more than 0.3 percent thiocyanates by weight of cement shall not be permitted.

2.4 RELATED MATERIALS

A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 ounces a square yard and complying with AASHTO M 182, Class 2.

B. Curing-sheet Materials: One of the following moisture-retaining covers, complying with ASTM C 171: waterproof paper, polyethylene film, or polyethylene-coated burlap.

C. Clear Curing and Sealing Compound (VOC compliant): ASTM C 309 with minimum 18 percent solids content. Use "Diamond Clear VOX" by Euclid Chemical Co. or accepted equivalent.

- D. Horizontal Joint Sealants: "Sonolastic SL2" by Sonneborn Building Products; "Sikaflex-2c SL" by Sika Corp.; "Eucolastic 2 SL" by Euclid Chemical Co.; or accepted equivalent.
- E. Vertical Joint Sealants: "Eucolastic 2" by Euclid Chemical Co.; "Sonolastic NP2" by Sonneborn Building Products; "Sikaflex-2c NS" by Sika Corporation; "Brutem 92" by Master Builders, Inc.; or accepted equivalent.
- F. Joint Filler: ASTM D 1751, ½-inch-thick, premolded, expansion joint filler strips.
- G. Backer Rod: "Sonofom" polyethylene closed-cell foam by Sonneborn Building Products or accepted equivalent.
- H. Water Stops: "Volclay Waterstop-RX," 1 inch by 3/4 inch, by American Colloid Company or accepted equivalent at below-grade wall construction joint locations and at locations shown in drawings.
- I. Chamfer Strips: Provide wood, metal, PVC, or rubber chamfer strips fabricated to provide 3/4-inch chamfer on exposed edges.
- J. Reglets: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217-inch-thick (26-gauge) galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
- K. Sleeves:
 - 1. Schedule 40, PVC for 12-inch diameter or smaller.
 - 2. ASTM A 53, hot-dip galvanized for larger than 12-inch diameter.
- L. Anchor Rods and Leveling Plates: Furnished in Section 05 12 00 and installed under this section.
- M. Non-shrink Grout: Corp of Engineers CRD-C 621. "Conspec 100" by Conspec Manufacturing Co.; "NS Grout" by Euclid Chemical Co.; "SikaGrout 212" by Sika Corp.; "Masterflow 928" or "Set Grout" by Master Builders, Inc.; "Sonogrout" by Sonneborn Building Products; or accepted equivalent.
- N. Bonding Agent: "Strongbond" by Conspec Manufacturing Co.; "SBR Latex" by Euclid Chemical Co.; "Everbond" by L&M Construction Chemicals, Inc.; "Acryl-Set" by Master Builders, Inc.; "SikaLatex" by Sika Corp.; "Sonocrete" by Sonneborn Building Products; or accepted equivalent.

2.5 PROPORTIONING AND MIX DESIGN

- A. Prepare design mixes for concrete. Use independent testing facility acceptable to Architect for preparing and reporting proposed mix designs.
- B. Where concrete production facility can establish uniformity of its production for concrete of similar strength and materials based on recent test data, the average strength used as a basis for determining mix design proportions shall exceed specified design strength by requirements of ACI 318, Section 5.3.2.1 or ACI 301, Section 3.9.
- C. When a concrete production facility does not have field-test records for calculation of standard deviation, the required average strength shall be determined in accordance with ACI 318, Section 5.3.2.2.
- D. Pozzolans:

1. Pozzolans may be substituted for cement in normal-weight concrete, including fly ash, at a maximum rate of 20 percent by weight or ground-granulated, blast-furnace slag at a maximum rate of 35 percent by weight.
 2. Submittals shall include actual mix design, including percentage of pozzolans and test results showing mix meets specified 7-day compressive strength where indicated, 28-day compressive strength, and air content.
 3. Protect and heat concrete containing pozzolans during cold weather conditions. Maintain protection and heat until 70 percent of specified design strength is achieved.
- E. Quantity of coarse aggregate in pounds must be in the range of 1.25 to 1.5 times quantity of fine aggregate in pounds.
- F. Concrete Quality:

Location	Required 7-day Compressive Strength psi	Required 28-day Compressive Strength psi	Maximum Water/Cement Ratio	Percent Entrained Air
Footings, foundation mat, foundation walls, structural slabs, beams, piers, and closure pours.	3,000	4,000	0.5	4.5*
Lean concrete	NA	1,500	0.65	4.5*

* Plus or minus 1.5 percent.

G. Slump:

1. 4 inches maximum, except lean concrete.
2. Concrete containing high-range, water-reducing admixture (superplasticizer) shall have a maximum slump of 9 inches unless otherwise accepted by Engineer. Concrete shall arrive at job site at a slump of 2 to 3 inches, shall be verified, then high-range, water-reducing admixture added to increase slump as required for placement and workability.
3. Type G superplasticizer may be added at plant if adequate quality control measures are implemented to verify slump and admixture quantities at plant before addition of superplasticizer. Concrete shall maintain required slump during transportation and placement. Quality control testing at plant shall be performed by an independent testing laboratory employed by Contractor and acceptable to Architect.
4. Ready Mix Concrete: ASTM C 94.

5. Provide batch ticket for each batch discharged and used in work indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

2.6 REINFORCING FABRICATION

- A. Fabricate bars to required lengths, shapes, and bends. Do not rebend or straighten reinforcement in manner that could weaken material.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Examine conditions under which concrete shall be placed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 FORMWORK INSTALLATION

- A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.
- B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, sleeves, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent concrete mortar leakage.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, etc., for easy removal.
- D. Erect forms in logical sequence to allow placement and inspection of reinforcement and other embedded items.
- E. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for concrete placement. Securely brace temporary openings, and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- F. Provide cleanout panels at bottoms of deep wall forms.
- G. Chamfer exposed corners and edges as indicated using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- H. Fit corners and joints with gaskets or tape to prevent leakage.
- I. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

- J. Sleeves: Provide sleeves in concrete formwork for plumbing, electrical, and mechanical penetrations. Coordinate size and location of sleeves with Contractors and mechanical, electrical, and plumbing drawings.
 - 1. Accurately place and secure in forms.
 - 2. Coordinate sleeve locations with reinforcing bars.
 - 3. Penetrations shall not occur through footings, piers, or columns unless shown in structural drawings.
- K. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing before placing concrete as required to prevent mortar leaks and maintain proper alignment.
- L. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated, or otherwise damaged form-facing materials are not acceptable. Apply new form-coating compound material. When forms are reused for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets.
- M. Clean and coat forms before erection. Do not coat forms in place.
- N. Place concrete plugs in exposed holes left by form-tie cones.

3.3 REINFORCEMENT PLACEMENT

- A. Clean reinforcement of loose rust, mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- B. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, hangers, or concrete brick as required.
 - 1. Wire-tie intersections as required to prevent displacement of reinforcement.
 - 2. Do not wet set reinforcing bars. Wet setting is not permitted.
- C. Place reinforcement to obtain at least minimum concrete coverages for protection of bars. Minimum required concrete cover is noted in drawings.
- D. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Use of nails in forms and use of clay brick to support reinforcement shall be prohibited.
- F. Lap bar splices as indicated. Stagger splices in adjacent bars. Wire-tie all splices.
- G. Coordinate placement of reinforcement with openings, including sleeves and other embedded items. Where one or more bars are interrupted, provide additional reinforcement at openings. Additional reinforcement is noted in drawings.
- H. Place concrete in manner to ensure alignment of elements remains unchanged.

- I. Touch up damaged epoxy-coated reinforcement in field after placement with epoxy patching material provided by coating manufacturer.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items including anchor rods, leveling plates, embedded plates, and angles required for other work attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.
- B. Do not wet set embedded items. Accurately position, support, and secure embedded items against displacing by formwork, construction, or concrete placement operations.
 1. Provide No. 3 rebar ties at top and bottom of anchor rods to maintain position or other accepted method.
- C. Anchor rods and embedded structural supports incorrectly located or damaged after installation shall be field modified, including repair or replacement, by Contractor.
 1. Notify Engineer of defective work. Submit proposed field modifications to Engineer for review and acceptance prior to making corrections.
 2. Proposed field modifications shall include design details and calculations, signed and sealed by a licensed Professional Engineer hired by Contractor.
 3. Field modifications shall be tested in accordance with Section 05 12 00. Perform pull-out tests and other appropriate tests on each repair.
 4. Cost of field modifications shall be borne entirely by Contractor at no additional cost to Owner. Contractor shall reimburse Owner for cost of additional testing required.

3.5 INSTALLATION OF NON-STRUCTURAL EMBEDDED ITEMS

- A. General: Notify other trades to permit installation of their work, including reglets, conduit, and piping and to coordinate requirements of this section. Cooperate with other trades in setting work as required.
- B. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings on outer face of exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.
- C. ACI 318, Article 6.3, and guidelines listed below apply to conduit and piping.
 1. Do not embed aluminum items unless coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.
 2. Other than those passing through concrete elements, do not embed items that are larger than one-third of thickness of concrete element in which they are embedded.
 3. Unless shown otherwise in structural drawings, install items as follows:

- a. Space at least 12 inches apart and not less than three diameters or widths on center.
- b. Place so they do not cross over each other within concrete elements.
- c. Place so they do not displace reinforcing bars from their proper location.
- d. Provide at least 3/4-inch concrete cover between items and reinforcing bars or concrete surfaces not exposed to weather or in contact with ground. Do not lay items on reinforcing bars. Provide at least 1½-inches concrete cover between items and concrete surfaces exposed to weather or earth.
- e. Securely position items by wire tying to support chairs or supports formed from reinforcing bars.
- f. Install sleeves at penetrations for nonstructural items passing through concrete elements.

3.6 PREPARATION OF FORM SURFACES

- A. General: Coat contact surfaces of forms with an accepted form-coating compound before placing reinforcement.
- B. Do not allow excess form-coating material to accumulate in forms or to come in contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- C. Coat steel forms with a nonstaining, rust-preventive material. Rust-stained steel formwork is not acceptable.

3.7 CONSTRUCTION JOINTS

- A. Locate and install construction joints not shown in drawings so as not to impair strength and appearance of structure as acceptable to Architect.
 1. Provide keyways at least 1 1/2 inches deep in construction joints in walls. Roughen joints between reinforced concrete walls and footings.
 2. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Do not continue reinforcement through sides of strip placements.
 3. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
 4. Provide water stops in construction joints below grade and where indicated. Install water stops to form continuous diaphragm in each joint. Make provisions to support and protect exposed water stops during progress of work. Field-fabricate joints in water stops in accordance with manufacturer's printed instructions.

3.8 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in.
 1. Notify other trades to permit installation of their work. Cooperate with other trades in setting work as required.

- B. General: Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete" and as specified.
- C. A maximum of 2 1/2 gallons for each cubic yard of total mix design water can be added in field. Water must be added prior to discharging and testing concrete. At no time shall total water exceed amount listed in accepted mix design.
- D. Deposit concrete continuously or in layers of such thickness that no concrete shall be placed on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within section. Provide construction joints if section cannot be placed continuously.
- E. Deposit concrete as nearly as practicable to its final location to avoid segregation caused by rehandling or flowing.
- F. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in manner to avoid inclined construction joints.
- G. Keep excavations free of water. Do not deposit concrete in water, mud, snow, or on frozen ground.
- H. Maximum drop of concrete shall not exceed 5 feet. Use hopper and trunk for greater drops.
- I. Maintain reinforcing in proper position during concrete placement.
- J. Contractor shall be responsible for controlling the proper placing of embedded pipe, conduit, and other embedded items. See section "Installation of Non-Structural Embedded Items" for additional information.
- K. Pumping concrete is permitted only if mix designs specifically prepared and used previously for pumping are submitted. Pump line shall have 5-inch-minimum inside diameter and be used with 5-inch pumps.

3.9 CONSOLIDATION

- A. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
- B. Do not use vibrators to transport concrete inside formwork.
- C. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Vibrators shall penetrate placed layer of concrete at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set.
- D. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- E. Do not allow vibrator to come in contact with form.

3.10 SURFACE FINISHES

- A. Rough-Form Finish: Provide as-cast, rough-form finish to formed concrete surfaces that shall be concealed in finished work or by other construction. Standard rough-form finish is concrete surface having texture imparted by form-facing material used, with tie holes and other defective areas repaired and patched, and fins or other projections exceeding 1/4 inch in height rubbed down or chipped off.

- B. Smooth-Form Finish: Provide smooth-form finish for formed concrete surfaces that shall be exposed to view or covered with material applied directly to concrete such as waterproofing, dampproofing, veneer plaster, painting, or other similar systems. Produce smooth-form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrically with minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 CURING AND PROTECTION

- A. Protect concrete from premature drying, excessive hot or cold temperature, and mechanical injury in accordance with provisions of ACI 301, Section 5.3.6.
- B. Curing Methods: Perform concrete curing by wet-curing or moisture-retaining cover curing or combinations thereof as specified.
- C. Provide wet-curing by following methods:
 - 1. Keep concrete surface continuously wet by covering with water.
 - 2. Use continuous water-fog spray.
 - 3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges with 4-inch lap over adjacent absorptive covers.
- D. Provide moisture-cover curing as follows:
 - 1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair holes or tears during curing period using cover material and waterproof tape.
- E. Curing Vertical-Formed Surfaces:
 - 1. Keep forms in place for minimum of 7 days, 14 days in cold weather or until concrete has achieved 70 percent of its design strength.
 - 2. If forms are removed before minimum time period, alternate methods of curing, wet-curing, moisture-retaining cover curing, or liquid-membrane curing, are required.
 - a. Contractor shall submit procedures to Architect for review.
 - b. Forms shall remain in place for a minimum of 24 hours when alternating methods of curing are used. For placement during cold weather, the minimum time to form removal shall be extended based on expected weather conditions and Contractor's submitted procedures.

- F. Cure concrete placed under cold-weather conditions completely covering exposed surface of concrete with moisture-retaining cover completely sealed around edges. Cure concrete 14 days minimum with concrete temperature at or above 40 degrees F or 7 days minimum with concrete temperature at or above 70 degrees F.
- G. During hot weather after concrete has hardened, loosen form ties, keeping forms in place, and apply water to inside face of form to keep concrete continuously moist.

3.12 COLD-WEATHER CONCRETING

- A. Place concrete in accordance with ACI 306.
- B. For cold-weather concreting (defined as a period when for more than 3 successive days the mean daily temperature is below 40 degrees F), maintain concrete temperature in accordance with Table 3.1, and maintain concrete protection in accordance with Table 5.3 in "Cold-Weather Concreting" reported by ACI Committee 306.
- C. When air temperature has fallen to or is expected to fall below 40 degrees F (4 degrees C), uniformly heat water and aggregates before mixing to obtain concrete mixture temperature recommended in Table 3.1 of ACI 306.
 - 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators.

3.13 HOT-WEATHER CONCRETING

- A. Place concrete in accordance with ACI 305.
- B. Cool ingredients before mixing to maintain concrete temperature below 85 degrees F at time of placement.
- C. Mixing water may be chilled or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water.
- D. Cover reinforcing steel with water-soaked burlap if temperature of reinforcing steel exceeds ambient air temperature.
- E. Wet forms thoroughly before placing concrete.
- F. Fog-spray forms and reinforcing steel just before placing concrete.
- G. Use water-reducing, retarding admixture when required by high temperature, low humidity, or other adverse placing conditions when acceptable to Architect.

3.14 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after form removal when acceptable to Architect.
 - 1. Cut out honeycombs, rock pockets, voids over 1/2 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but not to a depth of less than 1 inch. Make edges of cuts perpendicular to concrete surface. Thoroughly clean, dampen with water, and brush-coat area to be patched with bonding agent. Place patching mortar before bonding compound has dried.

2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so patching mortar will match surrounding color when dry. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
- B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. These include surface defects such as color, texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form-tie holes, and fill with dry-pack mortar or precast-cement cone plugs secured in place with bonding agent.
1. Where possible, repair concealed formed surfaces containing defects affecting concrete durability. If defects cannot be repaired, remove and replace concrete.
- C. Repair of Unformed Surfaces: Test unformed surfaces for smoothness, and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using template having required slope.
1. Repair finished unformed surfaces containing defects affecting concrete durability. These include surface defects such as crazing, cracks, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
- D. Repair methods not specified above may be used subject to acceptance of Architect.

3.15 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades unless otherwise shown or directed after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling required to complete work.

3.16 TOLERANCES

- A. Footings:
1. Variation of dimensions in plan: plus 2 inches or minus 1/2 inch.
 2. Variation of center from specified center in plan: 2 percent of width in direction of variation, plus or minus 2-inches maximum variation.
 3. Variation of bearing surface from specified elevation: plus or minus 1/2 inch, unless otherwise specified.
- B. Walls:
1. Variation in cross-sectional dimensions of piers and in thickness of walls: plus or minus 1/4 inch.
 2. Variation in plan from specified location in plan: plus or minus 1/2 inch for any member in any location.

3. Deviation in plan from straight lines parallel to specified linear building lines: 1/4 inch for adjacent members less than 20 feet apart or any wall length less than 20 feet; 1/2 inch for adjacent members 20 feet or more apart or any wall length of 20 feet and greater.
4. Deviation from plumb: 1/4 inch for any 10 feet of height; 1 inch maximum for entire height.
5. Variation in elevation from specified elevation: plus or minus 1/2 inch for any member in any location.
6. Deviation in elevation from lines parallel to specified grade lines: 1/4 inch for adjacent members less than 20 feet apart or any wall length less than 20 feet; 1/2 inch for adjacent members 20 feet or more apart or any wall length of 20 feet and greater.

C. Anchor Rods and Sleeves:

1. Variation from specified location in plan: plus or minus 1/4 inch.
2. Variation from specified elevation: plus or minus 1/2 inch.

D. Embedded Items (plates, angles, etc.) other than anchor rods and sleeves:

1. Variation from specified location in plan: plus or minus 1/4 inch.
2. Variation from specified elevation: plus or minus 1/4 inch.

CONCRETE MIX DESIGN SUBMITTAL FORM
 Submit separate form for each mix design

Project: _____ Location: _____

General Contractor: _____ Concrete Supplier: _____

Mix Design No: _____ Concrete Grade: _____

Use (Describe): _____

Methods of Placement (chute, pump, chute and buggy, etc.): _____

If placing by pumping, verify concrete mix can be pumped distances required in project: _____

A. DESIGN MIX INFORMATION:

Based on Standard Deviation Analysis: _____ or Trial Mix Design Data: _____

Design Characteristics - Density: _____ pcf; Strength: _____ psi (28-day);

Slump: _____ in. required BEFORE adding superplasticizer (if used)

Slump: _____ in. required AFTER adding superplasticizer (if used)

Entrained Air Content: _____ % specified

Materials:

Aggregates: (size; type; source; gradation; specification)

Coarse: _____

Fine: _____

<u>Other Materials:</u>	Type	Product-Manufacturer (Source)
-------------------------	------	-------------------------------

Cement: _____	_____
---------------	-------

Fly Ash: _____	_____
----------------	-------

Slag: _____	_____
-------------	-------

Admixtures:

Water Reducer: _____

Air-Entraining Agent: _____

High-Range, Water-Reducing Admixtures (superplasticizer): _____

Non-Corrosive Accelerator: _____

Other: _____

B. FINAL MIX DESIGN DATA:

RATIOS

Water _____ lb
 Cementitious _____ lb = _____
 Materials

Course Agg. _____ lb
 Fine Agg. _____ lb = _____

SPECIFIC GRAVITIES

Fine Agg. _____

Coarse Agg. _____

Other: _____

ADMIXTURES

W.R.: _____ oz. per 100 # Cement

HRWR: _____ oz. per 100 #Cement

Non-Corrosive Accelerator: _____ oz.
 Per 100# Cement

A.E.A.: _____ oz. per 100 # Cement

Other: _____ oz. per 100# Cement

PLASTIC CONCRETE

Initial Slump = _____ in. Air Content = _____ %

Final Slump = _____ in. Unit Dry Wt. = _____ pcf

Unit Wet Wt. = _____ pcf

STANDARD DEVIATION ANALYSIS (from experience records):

Number of Test Cylinders Evaluated: _____ Standard Deviation: _____

$f_{cr} = f_c + 1.34s$ or $f_{cr} = f_c + 2.33s - 500$
 (Refer to ACI for increased deviation factor when fewer than 30 tests are available.)

Mix # _____

Job Name _____

MIX PROPORTIONS

WEIGHT (LBS.)	ABSOLUTE VOL. (CU. FT.)
------------------	----------------------------

Cement: _____

Fly Ash: _____

Slag: _____

Fine Aggregate: _____

Coarse Aggregate: _____

Water: _____

Entrained Air: _____

Other: _____

TOTALS: _____

C. LABORATORY TEST DATA (HARDENED CONCRETE) :

COMPRESSIVE STRENGTH

Age (days)	Mix #1	Mix #2	Mix #3
7	_____	_____	_____
14	_____	_____	_____
28	_____	_____	_____
Other	_____	_____	_____

28-day average compressive strength: _____ psi

Mix design proportioned to achieve $f_{cr} = f_c + 1200$ psi (1400 psi for strength higher than 5000 psi at 28 days)

CHLORIDE ION CONTENT: _____

Remarks: _____

NOTE: Fill in all blank spaces. Use -0- (Zero) or N.A. (Not Applicable) where appropriate. See "Design and Control of Concrete Mixtures," 13th Edition by Portland Cement Association, for assistance in completing this form.

D. REQUIRED ATTACHMENTS:

- _____ Coarse aggregate gradation report and DOT certification
- _____ Fine aggregate gradation report and DOT certification
- _____ Concrete compressive strength data used for standard deviation calculations
- _____ Chloride ion data and related calculations
- _____ Rapid chloride permeability test report
- _____ Admixture compatibility certification letter

Submitted by
Ready-Mix
Supplier: Name _____

Address _____

Phone Number _____ Date _____

Main Plant Location _____ Miles from Project _____

Secondary Plant Location _____ Miles from Project _____

- - - END - - -

SECTION 03 41 33
PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies precast concrete construction including design not shown, fabrication, erection, and other related items.
- B. Precast concrete includes concrete tunnel sections shown on contract drawings.

1.2 RELATED WORK:

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

1.3 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: Precast concrete manufacturing plant shall be certified by Prestressed Concrete Institute, Plant Certification Program, prior to start of production.
- B. In lieu of above qualification, contractor shall meet and pay for following requirements:
 - 1. Retain an independent testing or consulting firm approved by Resident Engineer.
 - 2. This firm shall inspect precast plant at two-week intervals during production and issue a report, certified by a registered Professional Engineer verifying that materials, methods, products and quality control meet all requirements of specifications and drawings. When report indicates to the contrary, Resident Engineer may reject any or all products produced during period of noncompliance with above requirements.
- C. Precast concrete work shall be performed by firms that have demonstrated capability, subject to approval, to produce and erect type of work specified.
- D. Precast concrete manufacturer shall have on staff or shall retain a qualified registered Professional Structural Engineer to certify precast concrete conforms in all aspects to requirements of ACI 318.
- E. Erector Qualifications: Regularly engaged for at least 5 years in erection of precast structural concrete similar to requirements of this project.

F. Requirements of Regulatory Agencies: Local codes plus applicable specifications, standards and codes are a part of these specifications.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
 - 1. Erection Drawings:
 - a. Plans and/or elevations locating and defining material furnished by manufacturer.
 - b. Sections and details showing connections, cast-in items and their relation to structure.
 - c. Description of all loose, cast-in and field hardware.
 - d. Field installed anchor location drawings.
 - e. Erection sequences and handling requirements.
 - f. Dead, live and other applicable loads used in design.
 - 2. Production drawings:
 - a. Elevation view of each member.
 - b. Sections and details to indicate quantities and position of reinforcing steel, anchors, inserts, and essential embedded hardware.
 - c. Lifting and erection inserts.
 - d. Dimensions and finishes.
 - e. Prestress for strand and concrete strengths.
 - f. Estimated cambers.
 - g. Method of transportation.
- C. Product Design Criteria:
 - 1. Loadings for design:
 - a. Initial handling and erection stresses.
 - b. Dead and live loads as specified on contract drawings.
 - c. Other loads specified for member where they are applicable.
 - d. Deflection of precast members shall be limited as follows:
 - 1) Vertical Live Load - $\text{Span}/360$
 - e. Design shall provide for thermal movements of completed structure.
 - 2. Design calculations of products shall be performed by a registered Professional Engineer experienced in precast prestressed concrete design.
 - 3. Design shall be in accordance with applicable codes, ACI 318 and the PCI Design Handbook.
 - 4. Details for waterproof joints between precast members.
- D. Mix Designs: Submit proposed concrete mix designs and appropriate test data as specified in Part 2 of this section.

E. Permissible Design Deviations:

- 1. Design connections according to the conceptual details shown in the contract documents.
- 2. Design deviations will be permitted only after Resident Engineer's written approval of manufacturer's proposed design supported by complete design calculations and drawings.
- 3. Design deviations shall provide an installation equivalent to basic intent without incurring additional cost to the Government.

F. Test Reports: Concrete and other material.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Delivery and Handling:

- 1. Lift and support precast concrete members during manufacturing, stockpiling, transporting and erection operations only at lifting or supporting points, or both, as shown on contract and shop drawings, and with approved lifting devices. Lifting devices shall have a minimum safety factor of 4. Exterior lifting hardware shall have a minimum safety factor of 5.
- 2. Transportation, site handling, and erection shall be performed with acceptable equipment and methods, and by qualified personnel.

B. Storage:

- 1. Store all units off ground.
- 2. Place stored units so that identification marks are discernible.
- 3. Separate stacked members by battens across full width of each bearing point.
- 4. Stack so that lifting devices are accessible and undamaged.
- 5. Do not use upper members of stacked tier as storage area for shorter member or heavy equipment.

1.6 APPLICABLE PUBLICATIONS:

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

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

- A36/A36M-08.....Standard Specifications for Carbon Structural Steel
- A82-07.....Standard Specifications for Steel Wire, Plain, for Concrete Reinforcement
- A123/A123M-09.....Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- A153/A153M-09.....Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

- A185-07.....Standard Specifications for Steel Welded Wire,
Fabric, Plain, for Concrete Reinforcement
- A307-10.....Standard Specifications for Carbon Steel Bolts
and Studs
- A325-10.....Standard Specifications for Structural Bolts,
Steel, Heat Treated
- A416/A416M-10.....Standard Specifications for Steel Strand,
Uncoated Seven-Wire for Prestressed Concrete
- A615/A615M-09.....Standard Specifications for Deformed and Plain
Billet-Steel Bars for Concrete Reinforcement
- A706/A706M-09.....Standard Specifications for Low-Allow Steel
Deformed and Plain Bars for Concrete
Reinforcement
- A767/A767M-09.....Standard Specifications for Zinc-Coated
(Galvanized) Steel Bars for Concrete
Reinforcement
- A775/A775M-03 (R2008)Standard Specifications for Epoxy-Coated
Reinforcing Steel Bars
- C33-03.....Standard Specifications for Concrete Aggregates
- C88-05.....Standard Test Method for Soundness of Aggregates
by Use of Sodium Sulfate or Magnesium Sulfate
- C150-07.....Standard Specifications for Portland Cement
- C260-10.....Standard Specifications for Air-Entraining
Admixtures for Concrete
- C330-05.....Standard Specifications for Lightweight
Aggregates for Structural Concrete
- C494/C494M-10.....Standard Specification for Chemical Admixtures
for Concrete
- C. American Concrete Institute (ACI):
- 117-10.....Standard Specifications for Tolerances for
Concrete Construction and Materials
- 318-08.....Building Code Requirements for Structural
Concrete and Commentary
- D. Prestressed Concrete Institute (PCI):
- MNL-116-99.....Manual for Quality Control for Plants and
Production of Precast Concrete Products Fourth
Edition
- MNL-127-99.....Erector's Manual: Standards and Guidelines for
the Erection of Precast Concrete Products

F. American Welding Society (AWS):

D1.1/D1.1M-10.....Structural Welding Code - Steel

D1.4-11.....Structural Welding Code - Reinforcing Steel

PART 2 - PRODUCTS**2.1 MATERIALS:**

- A. Portland Cement: ASTM C150, Type I or III.
- B. Aggregates: ASTM C33, Coarse and Fine.
- C. Air-entraining Admixture: ASTM C260.
- D. Chemical Admixtures: ASTM C494.
- E. Mixing Water: Fresh, clean, and potable.
- F. Reinforcing Steel: ASTM A615, Grade 60, deformed.
- G. Weldable Reinforcing Steel: ASTM A706 Grade 60.
- H. Epoxy-Coated Reinforcing Steel: ASTM A775, Grade 60.
- I. Anchor Bolts: ASTM A307, low-carbon steel bolts, regular hexagon nuts and carbon steel washers, galvanized.
- J. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon bolts, and hardened washers complying with ASTM A325, galvanized.
- K. Welded Wire Fabric: ASTM A185.
- L. Wire Reinforcement: ASTM A82.
- M. Anchors and Inserts: ASTM A36 structural steel plates and shapes, ASTM A153 or ASTM A123 hot dipped galvanized finish.
- N. Non-metallic Shrinkage-Resistant Grout: Proprietary pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C-621. Minimum cube strength of 9000 psi at 28 days when placed at flowable consistency.
- O. Welded Studs: AWS D1.1.
- P. Welded Rebar: AWS D1.4.
- Q. Caulking and Sealants: Specified under Section 07 92 00, JOINT SEALANTS.
- R. Accessories: Provide clips, hangers, and other accessories required for installation of project units and for support of subsequent construction or finishes.

2.2 CONCRETE MIXES:

- A. Normal-Weight Concrete:
 1. Compressive Strength: 5000 psi minimum at 28 days.
 2. Release Strength: 3500 psi minimum at transfer of prestress.

2.3 FABRICATION:

- A. Fabrication Procedures: PCI MNL-116.

- B. Fabrication Tolerances: PC MNL-116 and ACI 117 for reinforcing steel placement.
- C. Finishes:
1. Standard Underside: Resulting from casting against approved forms using good industry practice in cleaning of forms, design of concrete mix, placing and curing. Small surface holes caused by air bubbles, normal color variations, normal form joint marks, and minor chips and spalls will be tolerated, but no major or unsightly imperfections, honeycomb, or other defects will be permitted.
 2. Standard Top: Result of vibrating screed and additional hand finishing at projections. Normal color variations, minor indentations, minor chips and spalls will be permitted. No major imperfections, honeycomb, or defects will be permitted.
 3. Exposed Vertical Ends: Strands shall be recessed and the ends of member will receive sacked finish.
- D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing, complying with CRSI recommendations. For exposed-to-view concrete surfaces, shear legs of supports are in contact with forms, provide supports with legs that are plastic protected or stainless steel protected.
- E. Use epoxy coated reinforcing whenever concrete cover is less than 2 inches for top surfaces exposed to deicing salts, brackish water or salt spray, such as in parking garage decks.
- F. Patching: Patching will be acceptable providing structural adequacy of product and appearance are not impaired.
- H. Defective Work: Precast concrete units which do not conform to specified requirements, including strength, tolerances, and finishes, shall be removed and replaced with precast concrete units that meet the requirements of this section. Contractor is also responsible for cost of corrections to other work affected by or resulting from corrections to precast concrete work.
- I. Fasteners: Cast in galvanized hardware such structural inserts, bolts and plates as required by drawings.

PART 3 - EXECUTION

3.1 ERECTION:

- A. Site Access: Provide suitable access to buildings, proper drainage, and firm, level bearing for hauling and erection equipment to operate under their own power.
- B. Preparation:
1. Provide true, level surfaces on bearing grades.

2. Place and accurate align tunnels sections.
- C. Installation: Installation of precast prestressed concrete shall be performed by the fabricator or a competent erector in accordance with PCI MNL-127. Lift members with suitable lifting devices at points provided by manufacturer. Temporary shoring and bracing, when necessary, shall comply with manufacturer's recommendations.
- D. Alignment: Align and level precast members as required by the approved shop drawings. Level out variations between adjacent members by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to Resident Engineer. Individual pieces are considered plumb, level, and aligned if the error does not exceed 1:500 excluding structural deformation caused by loads.

3.2 FIELD WELDING:

Field welding is to be done by qualified welders using equipment and materials compatible to base material in accordance with AWS D1.1 and AWS D1.4.

3.3 ATTACHMENTS:

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

3.4 INSPECTION AND ACCEPTANCE:

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

- - - E N D - - -

**SECTION 04 05 16
MASONRY GROUTING**

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies grout materials and mixes.

1.2 RELATED WORK:

- A. Grout used in Section:
- B. Grout Color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 TESTS:

- A. Test grout and materials specified.
- B. Certified test reports.
- C. Identify materials by type, brand name and manufacturer or by origin.
- D. Do not use materials until laboratory test reports are approved by COR.
- E. After tests have been made and materials approved, do not change without additional test and approval of COR.
- F. Testing:
 - 1. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
 - 2. Grout:
 - a. Test for compressive strength; ASTM C1019.
 - b. Grout compressive strength of 2500 psi at 28 days.
 - 3. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.4 SUBMITTALS:

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

- 2. Hydrated lime.
- 3. Admixtures.
- 4. Liquid acrylic resin.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

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

1.6 APPLICABLE PUBLICATIONS:

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

PART 2 - PRODUCTS

2.1 HYDRATED LIME:

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY GROUT:

ASTM C404, Size 8.

2.3 PORTLAND CEMENT:

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

2.4 WATER:

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

2.5 GROUT:

- A. Conform to ASTM C476 except as specified.
- B. Grout type proportioned by volume as follows:
 - 1. Fine Grout:
 - a. Portland cement or blended hydraulic cement: one part.
 - b. Hydrated lime: 0 to 1/10 part.

- c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
- 2. Coarse Grout:
 - a. Portland cement or blended hydraulic cement: one part.
 - b. Hydrated lime: 0 to 1/10 part.
 - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
 - d. Coarse aggregate: one to two times sum of volumes of cement and lime used.
- 3. Sum of volumes of fine and coarse aggregates: Do not exceed four times sum of volumes of cement and lime used.

PART 3 - EXECUTION

3.1 MIXING:

- A. Mix in a mechanically operated grout mixer.
 - 1. Mix grout for at least five minutes.
- B. Measure ingredients by volume. Measure by the use of a container of known capacity.
- C. Mix water with grout dry ingredients in sufficient amount to bring grout mixture to a pouring consistency.

3.2 GROUT USE LOCATIONS:

- A. Use fine grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is 50 mm (2 inches) or less.
- B. Use either fine grout or coarse grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is greater than 50 mm (2 inches).

- - - E N D - - -

SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies requirements for construction of masonry unit walls.

1.2 RELATED WORK

- A. Mortars and grouts: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING.
- B. Steel lintels and shelf angles: Section 05 50 00, METAL FABRICATIONS.
- C. Cavity insulation: Section 07 21 13, THERMAL INSULATION.
- D. Not Used.
- E. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.
- F. Color and texture of masonry units: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
 - 1. Ground Face Block, sample panel, 400 mm by 600 mm (8 inches by 16 inches,) showing full color range and texture of bricks, bond, and proposed mortar joints.
 - 2. Concrete masonry units, when exposed in finish work.
 - 3. Anchors, and ties, one each and joint reinforcing 1200 mm (48 inches) long.
 - 4. Not Used.
 - 5. Not Used.
- C. Shop Drawings:
 - 1. Special masonry shapes.
 - 2. Drawings, showing reinforcement, applicable dimensions and methods of hanging soffit or lintel masonry and reinforcing masonry for embedment of anchors for hung fixtures.
 - 3. Ceramic glazed structural facing tile or concrete masonry units for typical window and door openings, and, for special conditions as affected by structural conditions.
 - a. Drawings for reinforcing detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315 "Details and Detailing of Concrete Reinforcing" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement in wall at 1/4" = 1'-0" scale.

D. Certificates:

1. Certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
2. Indicating that the following items meet specification requirements:
 - a. Face brick.
 - b. Solid and load-bearing concrete masonry units, including fire-resistant rated units.
 - c. Ceramic glazed facing brick.
 - d. Glazed structural clay facing tile.
 - e. Structural clay tile units.
3. Testing laboratories facilities and qualifications of its principals and key personnel to perform tests specified.

E. Laboratory Test Reports:

1. Brick for pre-built masonry panels.
2. Ceramic glazed facing brick.

F. Manufacturer's Literature and Data:

1. Anchors, ties, and reinforcement.
2. Shear keys.
3. Reinforcing bars.

G. Material Data:

1. Each different cement product required for mortar and grout including name of manufacturer, brand, and type.
2. Each material and grade indicated for reinforcing bars.
3. Each type and size of joint reinforcement.
4. Each type and size of anchors, ties, and metal accessories.

H. Material Test Reports:

1. Mortars complying with property requirements of ASTM C 270.
2. Grout complying with ASTM C476; include description of type and proportions of grout ingredients.
3. Masonry units.

- I. Construction Procedures: Submit cold-weather construction and hot weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

1.4 NOT USED.**1.5 WARRANTY**

Warrant exterior masonry walls against moisture leaks and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period shall be five years.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A951-06.....Steel Wire for Masonry Joint Reinforcement.
- A615/A615M-09.....Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement.
- A675/A675M-03(R2009)....Standard Specification for Steel Bars, Carbon,
Hot-Wrought, Special Quality, Mechanical
PropertiesC34-03 Structural Clay Load-Bearing
Wall Tile
- C55-09.....Concrete Building Brick
- C56-10.....Structural Clay Non-Load-Bearing Tile
- C62-10.....Building Brick (Solid Masonry Units Made From
Clay or Shale)
- C67-09.....Sampling and Testing Brick and Structural Clay
Tile
- C90-11.....Load-Bearing Concrete Masonry Units
- C126-10.....Ceramic Glazed Structural Clay Facing Tile,
Facing Brick, and Solid Masonry Units
- C216-10.....Facing Brick (Solid Masonry Units Made From Clay
or Shale)
- C476-10.....Standard Specification for Grout for Masonry
- C612-10.....Mineral Fiber Block and Board Thermal Insulation
- C744-11.....Prefaced Concrete and Calcium Silicate Masonry
Units.
- D1056-07.....Flexible Cellular Materials - Sponge or Expanded
Rubber
- D2000-08.....Rubber Products in Automotive Applications
- D2240-05(R2010).....Rubber Property - Durometer Hardness
- D3574-08.....Flexible Cellular Materials-Slab, Bonded, and
Molded Urethane Foams
- F1667-11.....Fasteners: Nails, Spikes and Staples
- C. Masonry Industry Council:
Hot and Cold Weather Masonry Construction Manual-98 (R2000).
- D. American Welding Society (AWS):
D1.4-11 Structural Welding Code - Reinforcing Steel.
- E. Federal Specifications (FS):
FF-S-107C-00.....Screws, Tapping and Drive

- F. Brick Industry Association - Technical Notes on Brick Construction
(BIA):
- 11-2001.....Guide Specifications for Brick Masonry, Part I
 - 11A-1988.....Guide Specifications for Brick Masonry, Part II
 - 11B-1988.....Guide Specifications for Brick Masonry, Part III
Execution
 - 11C-1998.....Guide Specification for Brick Masonry Engineered
Brick Masonry, Part IV
 - 11D-1988.....Guide Specifications for Brick Masonry
Engineered Brick Masonry, Part IV continued
- G. Masonry Standards Joint Committee; Specifications for Masonry Structures
TMS 602-08/ACI 530.1-08/ASCE 6-08 (2008 MSJC Book Version TMS-0402-08).

1.7 SPECIAL INSTRUCTIONS

- A. Refer to Specification Section 01 45 29 and the schedule of Special Inspections.

1.8 MATERIAL EVALUATION/ QUALITY CONTROL

- A. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings".

PART 2 - PRODUCTS

2.1 NOT USED.

2.2 CONCRETE MASONRY UNITS

- A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.
 - 1. Unit Weight: Normal weight
 - 2. Fire rated units for fire rated partitions.
 - 3. Sizes: Modular.
 - 4. For molded faces used as a finished surface, use concrete masonry units with uniform fine to medium surface texture unless specified otherwise.
 - 5. Use bullnose concrete masonry units at corners exposed in finished work with 25 mm (one inch) minimum radius rounded vertical exterior corners (bullnose units).
 - 6. Customized units:
 - a. Ground Face Units
 - 1. Integral water repellent admixture.
 - 7. Use two-cell units for reinforced masonry applications.
- B. Load-bearing masonry Concrete Units: ASTM C 90 and as follows:
 - 1. Unit Compressive Strength: Minimum average net area compressive strength of 2,800 psi.
 - 2. Weight Classification: Normal weight.

2.3 MORTAR AND GROUT MATERIALS:

- A. Portland Cement: ASTM C 150, Type I. Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce required mortar color.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Aggregate for Mortar: ASTM C 144. For joints less than 1/4 inch, use aggregate graded with 100 percent passing No. 16 sieve.
- H. Water: Clean and potable.
- I: Additives: Not permitted.

2.4 Not used.

2.5 SHEAR KEYS

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

2.6 ANCHORS, TIES, AND REINFORCEMENT

- A. Steel Reinforcing Bars: ASTM A615M, deformed bars, grade as shown.
- B. Joint Reinforcement:
 1. Form from wire complying with ASTM A951.
 2. Galvanized after fabrication.
 3. Width of joint reinforcement 40 mm (0.16 inches) less than nominal width of masonry wall or partition.
 4. Cross wires welded to longitudinal wires.
 5. Joint reinforcement at least 3000 mm (10 feet) in length.
 6. Joint reinforcement in rolls is not acceptable.
 7. Joint reinforcement that is crimped to form drip is not acceptable.
 8. Maximum spacing of cross wires 400 mm (16 inch) to longitudinal wires.
 9. Ladder Design:
 - a. Longitudinal wires deformed 4 mm (0.16 inch) diameter wire.
 - b. Cross wires 2.6 mm (0.10 inch) diameter.
 10. Trussed Design:
 - a. Longitudinal and cross wires not less than 4 mm (0.16 inch nominal) diameter.
 - b. Longitudinal wires deformed.
 11. Multiple Wythes and Cavity wall ties:

- a. Longitudinal wires 4 mm (0.16 inch), two in each wythe with ladder truss wires 4 mm (0.16 inch) overlay, welded to each longitudinal wire.
 - b. Longitudinal wires 4 mm (0.16 inch) with U shape 4 mm (0.16 inch) rectangular ties extending into other wythe not less than 75 mm (3 inches) spaced 400 mm o.c. (16 inches). Adjustable type with U shape tie designed to receive 4 mm (0.16 inch) pintle projecting into other wythe 75 mm (3 inches min.).
- C. Adjustable Veneer Anchor for Frame Walls:
1. Two piece, adjustable anchor and tie.
 2. Anchor and tie may be either type; use only one type throughout.
 3. Loop Type:
 - a. Anchor: Screw-on galvanized steel anchor strap 2.75 mm (0.11 inch) by 19 mm (3/4 inch) wide by 225 mm (9 inches) long, with 9 mm (0.35 inch) offset and 100 mm (4 inch) adjustment. Provide 5 mm (0.20 inch) hole at each end for fasteners.
 - b. Ties: Triangular tie, fabricated of 5 mm (0.20 inch) diameter galvanized cold drawn steel wire. Ties long enough to engage the anchor and be embedded not less than 50 mm (2 inches) into the bed joint of the masonry veneer.
 4. Angle Type:
 - a. Anchor: Minimum 2 mm (16 gage) thick galvanized steel angle shaped anchor strap. Provide hole in vertical leg for fastener. Provide hole near end of outstanding leg to suit upstanding portion of tie.
 - b. Tie: Fabricate from 5 mm (0.20 inch) diameter galvanized cold drawn steel wire. Form "L" shape to be embedded not less than 50 mm (2 inches) into the bed joint of the masonry veneer and provide upstanding leg to fit through hole in anchor and be long enough to allow 50 mm (2 inches) of vertical adjustment.
- D. Dovetail Anchors:
1. Corrugated steel dovetail anchors formed of 1.5 mm (0.0598 inch) thick by 25 mm (1 inch) wide galvanized steel, 90 mm (3-1/2 inches) long where used to anchor 100 mm (4 inch) nominal thick masonry units, 140 mm (5-1/2 inches) long for masonry units more than 100 mm (4 inches) thick.
 2. Triangular wire dovetail anchor 100 mm (4 inch) wide formed of 4 mm (9 gage) steel wire with galvanized steel dovetail insert. Anchor length to extend at least 75 mm (3 inches) into masonry, 25 mm (1 inch) into 40 mm (1-1/2 inch) thick units.

3. Form dovetail anchor slots from 0.6 mm (0.0239 inch) thick galvanized steel (with felt or fiber filler).

E. Individual ties:

1. Rectangular ties: Form from 5 mm (3/16 inch) diameter galvanized steel rod to a rectangular shape not less than 50 mm (2 inches) wide by sufficient length for ends of ties to extend within 25 mm (1 inch) of each face of wall. Ties that are crimped to form drip are not permitted.
2. Adjustable Cavity Wall Ties:
 - a. Adjustable wall ties may be used at Contractor's option.
 - b. Two piece type permitting up to 40 mm (1-1/2 inch) adjustment.
 - c. Form ties from 5 mm (3/16 inch) diameter galvanized steel wire.
 - d. Form one piece to a rectangular shape 105 mm (4-1/8 inches) wide by length required to extend into the bed joint 50 mm (2 inches).
 - e. Form the other piece to a 75 mm (3 inch) long by 75 mm (3 inch) wide shape, having a 75 mm (3 inch) long bent section for engaging the 105 mm (4-1/8 inch) wide piece to form adjustable connection.

F. Wall Ties, (Mesh or Wire):

1. Mesh wall ties formed of ASTM A82, W0.5, 2 mm, (16 gage) galvanized steel wire 13 mm by 13 mm (1/2 inch by 1/2 inch) mesh, 75 mm (3 inches) wide by 200 mm (8 inches) long.
2. Rectangular wire wall ties formed of W1.4, 3 mm, (9 gage) galvanized steel wire 50 mm (2 inches) wide by 200 mm (8 inches) long.

G. Corrugated Wall Tie:

1. Form from 1.5 mm (0.0598 inch) thick corrugated, galvanized steel 30 mm (1-1/4 inches) wide by lengths so as to extend at least 100 mm (4 inches) into joints of new masonry plus 38 mm (1-1/2 inch) turn-up.
2. Provide 5 mm (3/16 inch) hole in turn-up for fastener attachment.

H. Adjustable Steel Column Anchor:

1. Two piece anchor consisting of a 6 mm (1/4 inch) diameter steel rod to be welded to steel with offset ends, rod to permit 100 mm (4 inch) vertical adjustment of wire anchor.
2. Triangular shaped wire anchor 100 mm (4 inches) wide formed from 5 (3/16 inch) diameter galvanized wire, to extend at least 75 mm (3 inches) into joints of masonry.

I. Adjustable Steel Beam Anchor:

1. Z or C type steel strap, 30 mm (1 1/4 inches) wide, 3 mm (1/8 inch) thick.
2. Flange hook not less than 38 mm (1 1/2 inches) long.

3. Length to embed in masonry not less than 50 mm (2 inches) in 100 mm (4 inch) nominal thick masonry and 100 mm (4 inches) in thicker masonry.
4. Bend masonry end not less than 40 mm (1 1/2 inches).

J. Ridge Wall Anchors:

1. Form from galvanized steel not less than 25 mm (1 inch) wide by 5 mm (3/16 inch) thick by 600 mm (24 inches) long, plus 50 mm (2 inch) bends.
2. Other lengths as shown.

2.7 PREFORMED COMPRESSIBLE JOINT FILLER

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

2.8 ACCESSORIES

- A. Weep Hole Wicks: Glass fiber ropes, 10 mm (3/8 inch) minimum diameter, 300 mm (12 inches) long.
- B. Box Board:
 1. Mineral Fiber Board: ASTM C612, Class 1.
 2. 25 mm (1 inch) thickness.
 3. Other spacing material having similar characteristics may be used subject to the COR's approval.
- C. Masonry Cleaner:
 1. Detergent type cleaner selected for each type masonry used.
 2. Acid cleaners are not acceptable.
 3. Use soapless type specially prepared for cleaning brick or concrete masonry as appropriate.
- D. Fasteners:
 1. Concrete Nails: ASTM F1667, Type I, Style 11, 19 mm (3/4 inch) minimum length.
 2. Masonry Nails: ASTM F1667, Type I, Style 17, 19 mm (3/4 inch) minimum length.
 3. Screws: FS-FF-S-107, Type A, AB, SF thread forming or cutting.
- E. Rebar Positioners: Steel wire positioners that are seated into the cores of masonry units.
 1. Wire Diameter: 0.1483 inch (9 gauge)
 2. Mill galvanized finish for interior walls.
 3. Acceptable products:
 - a. Corelock, by Wire-Bond.
 - b. DA810, by Dur-O-Wal/Dayton Superior.
 - c. No. 377 Center Cage Vertical Rod Positioner, by Heckmann Building Products.

D. OTHER PRODUCTS WHICH ARE ACCEPTED AS EQUIVALENT.2.9 PRE-BUILT MASONRY PANELS

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

2.10 EMBEDDED FLASHING MATERIALS

- A. Laminated Flashing: Manufacturer's standard laminated flashing of type indicated below:
 - 1. Copper-fabric Laminate: Copper sheet of 3 oz. A square foot indicated below, bonded between two layers of glass-fiber cloth or flashing/drainage composite with the copper bonded between a glass-fiber cloth backing and a non-woven wicking fabric face.
 - 2. Application: Use where flashing is fully concealed in masonry and as noted on drawings.
 - 3. Subject to compliance with requirements, products that may be incorporated in the work include the following:
 - a. "Copper Fabric" by Afco Products Inc.
 - b. "Type FCC-Fabric Covered Copper" by Phoenix Building Products.
 - c. "Copper Fabric Flashing" by Sandell Manufacturing Co.
 - d. "Multi-Flash 500 Series" or "Flash-Vent" by York Manufacturing, Inc.
 - 4. Where flashing is not embedded into interior wythe, provide termination bar and sealant at top of flashing on exterior face of interior wythe.
 - a. Provide stainless steel termination bar with anchor holes at 8 inches on center for flashing coated with asphalt.
 - b. Provide high-strength extruded polypropylene termination bar anchored at 8 inches on center for flashing not coated with asphalt.
- B. Membrane Flashing:
 - 1. Self-adhered, non-drooling membrane flashing, elastomeric lap sealant, and stainless steel termination bar with anchor holes at 8 inches on center.

2. Application: Use where flashing is fully concealed in masonry and as noted on drawings.
 3. Subject to compliance with requirements, products that may be incorporated in the work include the following:
 - a. "Perm-A-Barrier Wall Flashing" by Grace Construction Products.
 - b. "DA 1544 Flashing" and "DA 1510 Termination Bar" by Dur-O-Wal, Inc.
 - c. "Textroflash" with mastic and primer and "T1 Termination Bar" by Hohmann & Barnard, Inc.
 - d. "Sando-Seal" with termination bar by Sandell Manufacturing Co.
 - e. "Self Adhered (S/A) with Drip Membrane" by Hyload Cloaked Flashing System.
 - C. Adhesive/Sealant for Flashings: Type as recommended by manufacturer of flashing material for use indicated.
 - D. Drip Edge:
 1. 3/8-inch exposed hemmed edge by 2-inch stainless steel drip edge. Select product compatible with flashing.
 2. Subject to compliance with requirements, products that may be incorporated in the work include the following:
 - a. "DA 1525 Drip Edge Flashing" by Dur-O-Wal, Inc.
 - b. "DP" by Hohmann & Barnard, Inc.
 - c. "Drip Edge" by Johnson Bros.
 3. Drip edge must be adhered to flashing with manufacturer's approved adhesive.
 4. Isolate drip edge from metals other than stainless steel to avoid contact with drip edge.
 - E. Preformed Flashing:
 1. Inside corners, outside corners, end dams, and jambs are to be preformed and compatible with flashing and drip edge.
- 2.11 MORTAR AND GROUT MIXES
- A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 1. Do not use calcium chloride in mortar or grout.
 - B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification for Job-mixed Mortar and ASTM C 1142 for ready-mixed mortar of types indicated below:
 1. Limit cementitious materials in mortar to portland cement-lime.
 2. Use Type S mortar in the following locations:

- a. Walls which are below grade and in contact with earth.
 - b. Load-bearing walls.
 - c. Exterior above-grade nonload-bearing walls and parapets.
 - d. Areas where another type of mortar is not indicated.
3. Use Type N mortar in the following locations:
- a. Interior nonload-bearing partitions.
 - b. Veneers.
4. Provide entrained air content of 10 to 12 percent.
- C. Colored Mortar: Select pre-blended ingredients to produce color required.
- D. Colored Aggregate Mortar: Produce mortar of color required by use of colored aggregates in combination with selected cementitious materials.
- 1. Mix to match Architect's sample.
- E. Grout for Unit Masonry: Comply with ASTM C 476 and referenced unit masonry standard.
- F. Grout for Unit Masonry: Comply with ASTM C 476 and referenced unit masonry standard.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Protection:
- 1. Cover tops of walls with nonstaining waterproof covering, when work is not in progress. Secure to prevent wind blow off.
 - 2. On new work protect base of wall from mud, dirt, mortar droppings, and other materials that will stain face, until final landscaping or other site work is completed.
- B. Cold Weather Construction: See drawings for cold-weather construction requirements. In addition, comply with the following:
- 1. Do not lay masonry units that are wet or frozen..
 - 2. Remove masonry damaged by freezing conditions.
- C. Hot-Weather Construction: See drawings for hot-weather construction requirements.

3.2 CONSTRUCTION TOLERANCES

- A. Lay masonry units plumb, level and true to line within the tolerances as per MSJC requirements and as follows:
- B. Maximum variation from plumb:
- 1. In 3000 mm (10 feet) - 6 mm (1/4 inch).
 - 2. In 6000 mm (20 feet) - 10 mm (3/8 inch).
 - 3. In 12 000 mm (40 feet) or more - 13 mm (1/2 inch).
- C. Maximum variation from level:

1. In any bay or up to 6000 mm (20 feet) - 6 mm (1/4 inch).
 2. In 12 000 mm (40 feet) or more - 13 mm (1/2 inch).
- D. Maximum variation from linear building lines:
1. In any bay or up to 6000 mm (20 feet) - 13 mm (1/2 inch).
 2. In 12 000 mm (40 feet) or more - 19 mm (3/4 inch).
- E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:
1. Minus 6 mm (1/4 inch).
 2. Plus 13 mm (1/2 inch).
- F. Maximum variation in prepared opening dimensions:
1. Accurate to minus 0 mm (0 inch).
 2. Plus 6 mm (1/4 inch).

3.3 INSTALLATION GENERAL

- A. Keep finish work free from mortar smears or spatters, and leave neat and clean.
- B. Anchor masonry as specified in Paragraph, ANCHORAGE.
- C. Wall Openings:
1. Fill hollow metal frames built into masonry walls and partitions solid with mortar as laying of masonry progresses.
 2. If items are not available when walls are built, prepare openings for subsequent installation.
- D. Tooling Joints:
1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.
 2. Tool while mortar is soft enough to be compressed into joints and not raked out.
 3. Finish joints in exterior face masonry work with a jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.
 4. Tool Exposed interior joints in finish work concave unless specified otherwise.
- E. Partition Height:
1. Extend partitions at least 100 mm (four inches) above suspended ceiling or to overhead construction where no ceiling occurs.
 2. Extend following partitions to overhead construction.
 - a. Where noted smoke partitions, FHP (full height partition), and FP (fire partition) and smoke partitions (SP) on drawings.
 - b. Both walls at expansion joints.
 - c. Corridor walls.
 - d. Walls at stairway and stair halls, elevators, dumbwaiters, trash and laundry chute shafts, and other vertical shafts.
 - e. Walls at refrigerator space.

- g. Reinforced masonry partitions
 - 3. Extend finish masonry partitions at least four-inches above suspended ceiling and continue with concrete masonry units or structural clay tile to overhead construction:
- F. Lintels:
- 1. Lintels are not required for openings less than 1000 mm (3 feet 4 inches) wide that have hollow metal frames.
 - 2. Openings 1025 mm (3 feet 5 inches) wide to 1600 mm (5 feet 4 inches) wide with no structural steel lintel or frames, require a lintel formed of concrete masonry lintel or bond beam units filled with grout per ASTM C476 and reinforced with 1- #15m (1-#5) rod top and bottom for each 100 mm (4 inches) of nominal thickness unless shown otherwise.
 - 3. Precast lintels of 25 Mpa (3000 psi) concrete, of same thickness as partition, and with one Number 5 deformed bar top and bottom for each 100 mm (4 inches) of nominal thickness, may be used in lieu of reinforced CMU masonry lintels.
 - 4. Use steel lintels, for openings over 1600 mm (5 feet 4 inches) wide, brick masonry, and elevator openings unless shown otherwise.
 - 5. Doors having overhead concealed door closers require a steel lintel, and a pocket for closer box.
 - 6. Length for minimum bearing of 100 mm (4 inches) at ends.
 - 7. Build masonry openings or arches over wood or metal centering and supports when steel lintels are not used.
- G. Wall, Furring, and Partition Units:
- 1. Lay out field units to provide for running bond of walls and partitions, with vertical joints in second course centering on first course units unless specified otherwise.
 - 2. Align head joints of alternate vertical courses.
 - 3. At sides of openings, balance head joints in each course on vertical center lines of openings.
 - 4. Use no piece shorter than 100 mm (4 inches) long.
 - 5. On interior partitions provide a 6 mm (1/4 inch) open joint for caulking between and abutting masonry partitions.
 - 6. Use not less than 100 mm (4 inches) nominal thick masonry for free standing furring unless shown otherwise.
 - 7. Do not abut existing plastered surfaces except suspended ceilings with new masonry partitions.
- H. Use not less than 100 mm (4 inches) nominal thick masonry for fireproofing steel columns unless shown otherwise.

- I. Before connecting new masonry with previously laid, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.
- J. When new masonry partitions start on existing floors, machine cut existing floor finish material down to concrete surface.
- K. Structural Steel Encased in Masonry:
 - 1. Where structural steel is encased in masonry and the voids between the steel and masonry are filled with mortar, provide a minimum 25 mm (1 inch) mortar free expansion space between the masonry and the steel by applying a box board material to the steel before the masonry is laid.
 - 2. Do not place spacing material where steel is bearing on masonry or masonry is bearing on steel.
- L. Chases:
 - 1. Do not install chases in masonry walls and partitions exposed to view in finished work, including painted or coated finishes on masonry.
 - 2. Masonry 100 mm (4 inch) nominal thick may have electrical conduits 25 mm (1 inch) or less in diameter when covered with soaps, or other finishes.
 - 3. Full recess chases after installation of conduit, with mortar and finish flush.
 - 4. When pipes or conduits, or both occur in hollow masonry unit partitions retain at least one web of the hollow masonry units.
- M. Wetting and Wetting Test:
 - 1. Test and wet brick or clay tile in accordance with BIA 11B.
 - 2. Do not wet concrete masonry units or glazed structural facing tile before laying.
- N. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.
- O. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete (if any). Brace, tie and support as required to maintain position and shape during construction and curing of reinforced masonry.
- P. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and all other reasonable temporary loads that may be placed on them during construction.
- Q. Allow not less than the following minimum time to elapse after completion of members before removing shores or forms, provided suitable curing conditions have been obtained during the curing period.

1. 10 days for girders and beams.
2. 7 days for slabs.
3. 7 days for reinforced masonry soffits.

3.4 ANCHORAGE

A. Veneer to Frame Walls:

1. Use adjustable veneer anchors.
2. Fasten anchor to stud through sheathing with self drilling and tapping screw, one at each end of loop type anchor.
3. Space anchors not more than 400 mm (16 inches) on center vertically at each stud.

B. Veneer to Concrete Walls:

1. Install dovetail slots in concrete vertically at 600 mm (2 feet) on centers.
2. Locate dovetail anchors at 400 mm (16 inch) maximum vertical intervals.
3. Anchor new masonry facing to existing concrete with corrugated wall ties spaced at 400 mm, (16 inch) maximum vertical intervals, and at 600 mm (2 feet) maximum horizontal intervals. Fasten ties to concrete with power actuated fasteners or concrete nails.

C. Masonry Facing to Backup and Cavity Wall Ties:

1. Use individual ties for new work.
2. Stagger ties in alternate courses, and space at 400 mm (16 inches) maximum vertically, and 600 mm (2 feet) horizontally.
3. At openings, provide additional ties spaced not more than 900 mm (3 feet) apart vertically around perimeter of opening, and within 300 mm (12 inches) from edge of opening.
4. Anchor new masonry facing to existing masonry with corrugated wall ties spaced at 400 mm (16 inch) maximum vertical intervals and at every second masonry unit horizontally. Fasten ties to masonry with masonry nails.
5. Option: Use joint reinforcing for multiple wythes and cavity wall ties spaced not more than 400 mm (16 inches) vertically.
6. Tie interior and exterior wythes of reinforced masonry walls together with individual ties. Provide ties at intervals not to exceed 600 mm (24 inches) on center horizontally, and 400 mm (16 inches) on center vertically. Lay ties in the same line vertically in order to facilitate vibrating of the grout pours.

D. Anchorage of Abutting Masonry:

1. Anchor abutting masonry walls and partitions to concrete with dovetail anchors. Install dovetail slots vertically in concrete at centerline

of abutting wall or partition. Locate dovetail anchors at 400 mm (16 inch) maximum vertical intervals. Secure anchors to existing wall with two 9 mm (3/8 inch) by 75 mm (3 inch) expansion bolts or two power-driven fasteners.

2. Anchor abutting interior masonry partitions to existing concrete and existing masonry construction, with corrugated wall ties. Extend ties at least 100 mm (4 inches) into joints of new masonry. Fastened to existing concrete and masonry construction, with powder actuated drive pins, nail or other means that provides rigid anchorage. Install anchors at 400 mm (16 inch) maximum vertical intervals.

E. Masonry Furring:

1. Anchor masonry furring less than 100 mm (4 inches) nominal thick to masonry walls or to concrete with corrugated wall ties or dovetail anchors.
2. Space not over 600 mm (2 feet) on centers in both directions.

F. Anchorage to Steel Beams or Columns:

1. Use adjustable beam anchors on each flange.
2. At columns weld the 6 mm (1/4 inch) steel rod to steel columns at 300 mm (12 inch) intervals, and place wire ties in masonry courses at 400 mm (16 inches) maximum vertically.

3.5 REINFORCEMENT

A. Joint Reinforcement:

1. General: Provide continuous horizontal joint reinforcement as indicated.
Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls; 1/2 inch elsewhere. Lap reinforcing a minimum of 6 inches.
2. Install single-wythe horizontal joint reinforcing in concrete masonry veneer at 16 inches on center vertically, unless noted otherwise.
3. Cut or interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
4. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, pipe enclosures, and other special conditions.
5. Reinforcing may be used in lieu of individual ties for anchoring brick facing to CMU backup in exterior masonry walls.
6. Brick veneer over frame backing walls does not require joint reinforcement.

7. Wherever brick masonry is backed up with stacked bond masonry, joint reinforcement is required in every other course of CMU backup, and in corresponding joint of facing brick.

B. Steel Reinforcing Bars:

1. Install in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for lintels and bond beam horizontal reinforcement. Install in wall cavities of reinforced masonry walls where shown.
2. Use grade 60 bars if not specified otherwise.
3. Bond Beams:
 - a. Form Bond beams of load-bearing concrete masonry units filled with ASTM C476 grout and reinforced with 2-#15m (#5) reinforcing steel unless shown otherwise. Do not cut reinforcement.
 - b. Brake bond beams only at expansion joints and at control joints, if shown.
4. Stack Bond:
 - a. Locate additional joint reinforcement in vertical and horizontal joints as shown.
 - b. Anchor vertical reinforcement into the foundation or wall or bond beam below and hold in place.
 - c. Provide temporary bracing for walls over 8 ft. tall until permanent horizontal bracing is completed.
5. Grout openings:
 - a. Leave cleanout holes in double wythe walls during construction by omitting units at the base of one side of the wall.
 - b. Locate 75 mm x 75 mm (3 in. x 3 in.) min. clean-out holes at location of vertical reinforcement.
 - c. Keep grout space clean of mortar accumulation and sand debris. Clean the grout space every day using a high pressure jet stream of water, or compressed air, or industrial vacuum, or by laying wood strips on the metal ties as the wall is built. If wood strips are used, lift strips with wires as the wall progresses and before placing each succeeding course of wall ties.

3.6 BRICK EXPANSION AND CMU CONTROL JOINTS.

- A. Provide brick expansion (BEJ) and CMU control (CJ) joints where shown on drawings.
- B. Keep joint free of mortar and other debris.
- C. Where joints occur in masonry walls.
 1. Install preformed compressible joint filler in brick wythe.

2. Install cross shaped shear keys in concrete masonry unit wythe with preformed compressible joint filler on each side of shear key unless otherwise specified.
 3. Install filler, backer rod, and sealant on exposed faces.
- D. Use standard notched concrete masonry units (sash blocks) made in full and half-length units where shear keys are used to create a continuous vertical joint. E. Interrupt steel joint reinforcement at expansion and control joints unless otherwise shown.
- F. Fill opening in exposed face of expansion and control joints with sealant as specified in Section 07 92 00, JOINT SEALANTS.

3.7 BUILDING EXPANSION AND SEISMIC JOINTS

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

3.8 ISOLATION SEAL

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

3.9 Not Used.

3.10 CONCRETE MASONRY UNITS

- A. Kind and Users:
 1. Provide special concrete masonry shapes as required, including lintel and bond beam units, sash units, and corner units. Use solid concrete masonry units, where full units cannot be used, or where needed for anchorage of accessories.
 2. Provide solid load-bearing concrete masonry units or grout the cell of hollow units at jambs of openings in walls, where structural members impose loads directly on concrete masonry, and where shown.

3. Provide rounded corner (bullnose) shapes at opening jambs in exposed work and at exterior corners.
 4. Do not use brick jambs in exposed finish work.
 5. Use concrete building brick only as filler in backup material where not exposed.
 6. Masonry assemblies shall meet the required fire resistance in fire rated partitions of type and construction that will provide fire rating as shown.
 7. Structural Clay Tile Units (Option):
 - a. Structural clay tile units load-bearing or non-load bearing as required, may be used in lieu of concrete masonry units, only, but not as an exposed surface, foundation walls or where otherwise noted.
 - b. Set units according to applicable requirements specified for concrete masonry units.
 - c. Use brick or load-bearing structural clay tile units, with cores set vertically, and filled with grout where structural members impose concentrated load directly on structural clay tile masonry.
 8. Where lead lined concrete masonry unit partitions terminate below the underside of overhead floor or roof deck, fill the remaining open space between the top of the partition and the underside of the overhead floor or roof deck, with standard concrete masonry units of same thickness as the lead lined units.
- B. Laying:
1. Lay concrete masonry units with 10 mm (3/8 inch) joints, with a bond overlap of not less than 1/4 of the unit length, except where stack bond is required.
 2. Do not wet concrete masonry units before laying.
 3. Bond external corners of partitions by overlapping alternate courses.
 4. Lay first course in a full mortar bed.
 5. Set anchorage items as work progress.
 6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill such voids with mortar or grout.
 7. Provide a 6 mm (1/4 inch) open joint for caulking between existing construction, exterior walls, concrete work, and abutting masonry partitions.
 8. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
 9. Lay concrete masonry units so that cores of units, that are to be filled with grout, are vertically continuous with joints of cross

- webs of such cores completely filled with mortar. Unobstructed core openings not less than 50 mm (2 inches) by 75 mm (3 inches).
10. Do not wedge the masonry against the steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
 11. Install deformed reinforcing bars of sizes shown.
 12. Steel reinforcement, at time of placement, free of loose flaky rust, mud, oil, or other coatings that will destroy or reduce bond.
 13. Steel reinforcement in place before grouting.
 14. Minimum clear distance between parallel bars: One bar diameter.
 15. Hold vertical steel reinforcement in place by centering clips, caging devices, tie wire, or other approved methods, vertically at spacings noted.
 16. Support vertical bars near each end and at intermediate intervals not exceeding 192 bar diameters.
 17. Reinforcement shall be fully encased by grout or concrete.
 18. Splice reinforcement or attach reinforcement to dowels by placing in contact and secured or by placing the reinforcement within 1/5 of the required bar splice length.
 19. Stagger splices in adjacent horizontal reinforcing bars. Lap reinforcing bars at splices a minimum of 40 bar diameters.
 20. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.
 21. Cavity and joint horizontal reinforcement may be placed as the masonry work progresses.
 22. Rake joints 6 to 10 mm (1/4 to 3/8 inch) deep for pointing with colored mortar when colored mortar is not full depth.
- C. Waterproofing Parging:
1. Parge earth side of concrete masonry unit basement walls with mortar applied in two coats, each coat 6 mm (1/4 inch) thick.
 2. Clean wall surfaces to receive parging of dirt, oil, or grease, and moisten before application of first coat.
 3. Roughen first coat when partially set, permit to hardened for 24 hours, and moisten before application of second coat.
 4. Keep second coat damp for at least 48 hours.
 5. Thicken parging and round to form a cove at the junction of outside wall face and footing.

3.11 NOT USED.

3.12 POINTING

- A. Fill joints with pointing mortar using rubber float trowel to rub mortar solidly into raked joints.

- B. Wipe off excess mortar from joints of glazed masonry units with dry cloth.
- C. Finish exposed joints in finish work with a jointing tool to provide a smooth concave joint unless specified otherwise.
- D. At joints with existing work match existing joint.

3.13 GROUTING

A. Preparation:

1. Clean grout space of mortar droppings before placing grout.
2. Close cleanouts.
3. Install vertical solid masonry dams across grout space for full height of wall at intervals of not more than 9000 mm (30 feet). Do not bond dam units into wythes as masonry headers.
4. Verify reinforcing bars are in cells of units or between wythes as shown.

B. Placing:

1. Place grout by hand bucket, concrete hopper, or grout pump.
2. Consolidate each lift of grout after free water has disappeared but before plasticity is lost.
3. Do not slush with mortar or use mortar with grout.
4. Interruptions:
 - a. When grouting must be stopped for more than an hour, top off grout 40 mm (1-1/2 inch) below top of last masonry course.
 - b. Grout from dam to dam on high lift method.
 - c. A longitudinal run of masonry may be stopped off only by raking back one-half a masonry unit length in each course and stopping grout 100 mm (4 inches) back of rake on low lift method.

C. Puddling Method:

1. Double wythe masonry constructed grouted in lifts not to exceed 300 mm (12 inches) or less than 50 mm (2 inches) wide.
2. Consolidate by puddling with a grout stick during and immediately after placing.
3. Grout the cores of concrete masonry units containing the reinforcing bars solid as the masonry work progresses.

D. Low Lift Method:

1. Construct masonry to a height of 1.5 m (5 ft) maximum before grouting.
2. Grout in one continuous operation and consolidate grout by mechanical vibration and reconsolidate after initial water loss and settlement has occurred.

E. High Lift Method:

1. Do not pour grout until masonry wall has properly cured a minimum of 4 hours.
2. Place grout in lifts not exceeding 1.5 m (5 ft).
3. Exception:
Where the following conditions are met, place grout in lifts not exceeding 3.86 m (12.67 ft).
 - a. The masonry has cured for at least 4 hours.
 - b. The grout slump is maintained between 254 and 279 mm (10 and 11 in).
 - c. No intermediate reinforced bond beams are placed between the top and the bottom of the pour height.
4. When vibrating succeeding lifts, extend vibrator 300 to 450 mm (12 to 18 inches) into the preceding lift to close any shrinkage cracks or separation from the masonry units.

3.14 PLACING REINFORCEMENT

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the Contract Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
- B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 25 mm (1 inch), whichever is greater.
- C. For columns, piers and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1 1/2 times the nominal bar diameter or 38 mm (1-1/2 inches), whichever is greater. Provide lateral ties as indicated.
- D. Splice reinforcement bars where shown; do not splice at other places unless accepted by the COR. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.
- E. Provide not less than minimum lap as indicated on shop drawings, or if not indicated, as required by governing code.
- F. Weld splices where indicated. Comply with the requirements of AWS D1.4 for welding materials and procedures.

- G. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations.
- H. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations. Lap joint reinforcement not less than 150 mm (6 inches) at ends. Use prefabricated "L" and "T" sections to provide continuity at corners and intersections. Cut and bend joint reinforcement as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- I. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.
- J. Anchor reinforced masonry walls to non-reinforced masonry where they intersect.

3.15 NOT USED.

3.16 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
 - 1. With full mortar coverage on horizontal and vertical face shells.
 - 2. For starting course on foundations, provide full mortar coverage on horizontal and vertical face shells and webs.
 - 3. Bed webs in mortar at grouted cells.
- B. Cut joints flush for masonry walls to be concealed or covered by other materials unless otherwise indicated.

3.17 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

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

- required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.
2. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
 3. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.
- E. Columns, Piers and Pilasters:
1. Use CMU units of the size, shape and number of vertical core spaces shown. If not shown, use units which provide minimum clearances and grout coverage for number and size of vertical reinforcement bars shown.
 2. Provide pattern bond shown, or if not shown, alternate head joints in vertical alignment.
 3. Where bonded pilaster construction is shown, lay wall and pilaster units together to maximum pour height specified.
- F. Grouting:
1. Use "Fine Grout" per ASTM C476 for filling spaces less than 100 mm (4 inches) in one or both horizontal directions.
 2. Use "Coarse Grout" per ASTM C476 for filling 100 mm (4 inch) spaces or larger in both horizontal directions.
 3. Grouting Technique: At the Contractor's option, use either low-lift or high-lift grouting techniques subject to requirements which follow.
- G. Low-Lift Grouting:
1. Provide minimum clear dimension of 50 mm (2 inches) and clear area of 5160 mm² (8 square inches) in vertical cores to be grouted.
 2. Place vertical reinforcement prior to grouting of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters nor 3 m (10 feet).

3. Lay CMU to maximum pour height. Do not exceed 1.5 m (5 foot) height, or if bond beam occurs below 1.5 m (5 foot) height, stop pour 38 mm (1-1/2 in) below top of bond beam.
4. Pour grout using chute container with spout or pump hose. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 38 mm (1-1/2 inches) below top course of pour.
5. Bond Beams: Stop grout in vertical cells 38 mm (1-1/2 inches) below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

H. High-Lift Grouting:

1. Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension and area is 75 mm (3 inches) and 6450 mm² (10 square inches), respectively.
2. Provide cleanout holes in first course at all vertical cells which are to be filled with grout.
3. Use units with one face shell removed and provide temporary supports for units above, or use header units with concrete brick supports, or cut openings in one face shell.
4. Construct masonry to full height of maximum grout pour specified, prior to placing grout.
5. Limit grout lifts to a maximum height of 1.5 m (5 feet) and grout pour to a maximum height of 7.3 m (24 feet), for single wythe hollow concrete masonry walls, unless otherwise indicated.
6. Place vertical reinforcement before grouting. Place before or after laying masonry units, as required by job conditions. Tie vertical reinforcement to dowels at base of masonry where shown and thread CMU over or around reinforcement. Support vertical reinforcement at intervals not exceeding 192 bar diameters nor 3 m (10 feet).
7. Where individual bars are placed after laying masonry, place wire loops extending into cells as masonry is laid and loosed before mortar sets. After insertion of reinforcement bar, pull loops and bar to proper position and tie free ends.
8. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing indicated.
9. Place horizontal beam reinforcement as the masonry units are laid.

10. Embed lateral tie reinforcement in mortar joints where indicated. Place as masonry units are laid, at vertical spacing shown.
11. Where lateral ties are shown in contact with vertical reinforcement bars, embed additional lateral tie reinforcement in mortar joints. Place as shown, or if not shown, provide as required to prevent grout blowout or rupture of CMU face shells, but provide not less than 4.1 mm diameter (8 gage) wire ties spaced 400 mm (16 inches) o.c. for members with 500 mm (20 inches) or less side dimensions, and 200 mm (8 inches) o.c. for members with side dimensions exceeding 500 mm (20 inches).
12. Preparation of Grout Spaces: Prior to grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcement and adjust to proper position. Clean top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.
13. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.
14. Place grout by pumping into grout spaces unless alternate methods are acceptable to the COR.
15. Limit grout pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation. Place grout in lifts which do not exceed 1.5 m (5 feet). Allow not less than 30 minutes, nor more than one hour between lifts of a given pour. Mechanically consolidate each grout lift during pouring operation.
16. Place grout in lintels or beams over openings in one continuous pour.
17. Where bond beam occurs more than one course below top of pour, fill bond beam course to within 25 mm (1 inch) of vertically reinforced cavities, during construction of masonry.
18. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 38 mm (1-1/2 inches) of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

3.18 CLEANING AND REPAIR

A. General:

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

B. Brickwork:

1. First wet surfaces with clean water, then wash down with a solution of soapless detergent. Do not use muriatic acid.
2. Brush with stiff fiber brushes while washing, and immediately thereafter hose down with clean water.
3. Free clean surfaces of traces of detergent, foreign streaks, or stains of any nature.

C. Concrete Masonry Units:

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

D. Glazed Structural Facing Tile or Brick Units:

1. Clean as recommended by tile or brick manufacturer. Protect light colored mortar joints from discoloration during cleaning.
2. Prepare schedule of test locations.

3.19 WATER PENETRATION TESTING

- A. Seven days before plastering or painting, in the presence of COR, test solid exterior masonry walls for water penetration.
- B. Direct water on masonry for a period of one hour at a time when wind velocity is less than five miles per hour.
- C. Should moisture appear on inside of walls tested, make additional tests at other areas as directed by COR.
- D. Correct the areas showing moisture on inside of walls, and repeat test at repaired areas, to insure that moisture penetration has been stopped.

- - - E N D - - -

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including general and supplementary conditions and Division 1 specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

- A. This section includes Structural Steel.

1.3 QUALITY ASSURANCE

- A. Comply with latest editions of:

1. American Institute of Steel Construction (AISC) Publications:
 - a. Manual of Steel Construction ("Allowable Stress Design" or "Load and Resistance Factor Design"). (Includes "Specification for Structural Steel Buildings," "Code of Standard Practice for Steel Buildings and Bridges," "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts," "LRFD Specification for Steel Hollow Structural Sections," "LRFD Specification for Single-Angle Members.")
 - b. Hollow Structural Sections Connections Manual (includes "AISC Specification for the Design of Steel Hollow Structural Sections").
 - c. Allowable Stress Design of Simple Shear Connections, or Load and Resistance Factor Design of Simple Shear Connections.
2. American Welding Society, Inc. (AWS)
 - a. AWS D1.1 "Structural Welding Code - Steel."
3. American Hot-Dip Galvanizers Association, Inc.; Zinc Institute Inc.
 - a. "Inspection Manual for Hot-Dip Galvanized Products."
4. Steel Structures Painting Council (SSPC)
 - a. "Surface Preparation Specifications."

- B. Qualifications for Welding Work:

1. Qualify welding processes and welding operators in accordance with AWS standards.
2. Provide one of the following certifications for welders to be employed in work.
 - a. Certification of satisfactorily passing AWS qualification tests within previous 12 months to perform type of welding in work.
 - b. Work record signed by supervisor showing regular employment within previous 12 months to perform type of welding in work.

- C. Qualifications for Fabricator, Detailer, and Erector:

1. Fabricator, Detailer, and Erector of structural steel shall have not less than 3 years of experience in fabrication, detailing, and erection of structural steel. Fabricators currently certified under the AISC Quality Certification Program for Structural Steel Building Fabricators are acceptable.
2. Submit written description of ability.
3. At completion of fabrication, Fabricator shall submit a Certificate

of Compliance to Special Inspector and to Code Enforcement Official stating work was performed in accordance with approved Construction Documents.

1.4 SPECIAL INSPECTIONS

- A. Refer to Specification Section 01 45 29 and Schedule of Special Inspections.

1.5 MATERIAL EVALUATION/QUALITY CONTROL

- A. Contractor shall employ testing laboratory acceptable to Engineer and Architect to perform material evaluation tests.
- B. Submit testing service qualifications demonstrating experience with similar types of projects.
- C. The Registered Design Professionals (RDPs) for Structural Engineering and Architecture will visit construction site at appropriate intervals to determine if work is in general conformance with Contract Documents and specifications. Notify RDPs 48 hours before anticipated time of completion for a given section of work so they may determine if site observations are required. If site observations are required, do not conceal framing until the RDPs have had opportunity to make observations.

1.6 SUBMITTALS

- A. General: Review of submittals will be for general conformance only. Compliance with requirements for materials, fabrication, erection, and dimensioning of structural steel shall be Contractor's responsibility. Resubmitted shop drawings shall have revisions identified and dated.
- B. Connections: Submit proposed connection types and calculations for review before preparing detailed shop drawings.
- C. Shop Drawings: Submit detailed drawings showing:
 - 1. Reference Contract Drawing number and addendum number in each shop drawing.
 - 2. Shop erection details including cuts, copes, camber, connections, holes, bolts, and other pertinent information.
 - 3. Connection loads.
 - 4. Material, including ASTM designations and grades or manufacturer's data as appropriate.
 - 5. Welds with size, length, and type.
 - 6. Anchor rod locations.
 - 7. Shop drawings shall be checked by detailer and noted as checked in drawings before submitting. Failure to submit checked shop drawings will be cause for their return without review.
 - 8. If drawings are not prepared by detailer under direct control of Fabricator, Fabricator shall stamp each drawing and initial or sign stamp to certify review and approval of drawings and conformance with Fabricator's shop practice and capability.
- D. Material Data: Submit to Special Inspector and Engineer laboratory test reports and other data as required to show compliance with specifications. Submit producer's or manufacturer's specifications and installation instructions for the following products:
 - 1. Structural steel, including certified copies of mill reports covering chemical and physical properties.

2. High-strength bolts, including nuts and washers.
 3. Unfinished bolts and nuts.
 4. Structural steel primer paint if used.
 5. Welding electrodes.
 6. Post-installed anchors (expansion, sleeve, or chemical adhesive) if used.
- E. Bolt Certification: Submit to Special Inspector and Engineer certification that bolts, nuts, and washers furnished comply with specifications. Submit manufacturer's inspection certificates for mill tests. For fasteners to be accepted, certification numbers must appear on the product containers and correspond to identification numbers in mill test reports. Manufacturer's symbol and grade markings must appear on bolts and nuts.
- F. Field Modifications: Submit drawings showing field modifications required to correct errors in shop drawings, fabrication, or erection.
- G. Erector's Welding Procedure Specifications: Submit welding procedure specifications for joint types detailed for field welding.

1.7 PRODUCT HANDLING

- A. Store material in horizontal position on supports above ground.
- B. Protect from weather, and keep free of dirt and debris.
- C. Handle material carefully so it is not bent or marred.
- D. Repair or replace damaged materials.

1.8 WORKMANSHIP

- A. Contractor shall be responsible for correction of work not conforming to specified requirements. Correct deficient work as directed by Architect.
- B. Remove work found to be defective. Replace with new acceptable work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall be new and free from rust.
- B. Rolled-Steel Plates, Bars, and Angles: ASTM A 36.
- C. Rolled-Steel C Shapes: ASTM A 36.
- D. Rolled-Steel W Shapes: ASTM A 992.
- E. Steel Pipe: ASTM A 53, Type E or S, Grade B.
- F. Hollow Structural Sections (HSS): ASTM A 500, Grade B or C.
- G. Unfinished Bolts, Nuts, and Washers: ASTM A 307, Grade A.
- H. High-Strength Bolts: ASTM A 325 or A 490, Type 1, plain.
- I. High-Strength Bolts, Galvanized: ASTM A 325, Type 1.
- J. Anchor Rods: ASTM F 1554, Grade 36.
- K. Threaded Rods: ASTM A 36.
- L. Nuts: ASTM A 563. Grade and finish to match bolt or rod type.
- M. Washers: ASTM F 436 (ASTM F 844 for ASTM A 307 bolts, A 36 rods, and F 1554 Grade 36 anchor rods). Finish to match bolt or rod type.
- N. Electrodes: E70 and in accordance with AWS.

- O. Steel Primer Paint: For steel scheduled to receive finish paint, use primer compatible with finish paint specified in Division 9.
- P. Hot-Dip Galvanizing: Hot-dip galvanize after fabricating in accordance with ASTM A 123. Restraighten members after galvanizing if necessary to be square and true. Items to be hot-dip galvanized are identified in drawings.
- Q. Cold-Galvanizing: Zinc-rich, cathodic-acting paint. "Tneme-Zinc 90-97" by Tnemec Inc.; "ZRC Galvalite" by ZRC Worldwide; or accepted equivalent. Items to be cold-galvanized are identified in drawings for field touch up of galvanized surfaces.
- R. Expansion Anchors: "Kwik-Bolt 3" by Hilti; "Trubolt Wedge Anchors" by ITW Ramset/Red Head; "Power-Stud" by Powers Fasteners; "Wedge-All" by Simpson/Strong-Tie; or accepted equivalent.
- S. Sleeve Anchors: "HLC Sleeve Anchor" by Hilti; "Dynabolt Sleeve Anchor" by ITW Ramset/Red Head; "Power-Bolt" by Powers Fasteners; "Sleeve-All" by Simpson/Strong-Tie; or accepted equivalent.
- T. Chemical Adhesive Anchors:
 - 1. Anchors to solid concrete, grouted CMU, solid brick, or stone:
 - a. Anchors for use when base material temperature is 0°F or greater: "HIT-Ice" by Hilti; "Epcon A7" by ITW Ramset/Red Head; "AC 100 Plus" by Powers Fasteners; "AT Acrylic-Tie" by Simpson/Strong-Tie; or accepted equivalent.
 - b. Anchors for use when base material temperature is 40°F or greater; "HIT HY 150" or "HIT HY 150 MAX" by Hilti; "Epcon C6" by ITW Ramset/Red Head; "Power-Fast" by Powers Fasteners; "ET Epoxy-Tie" by Simpson/Strong-Tie; or accepted equivalent.
 - 2. Anchors to hollow masonry (brick or hollow CMU):
 - a. Anchors for use when base material temperature is 0°F or greater: "Epcon A7" by ITW Ramset/Red Head; "AC 100 Plus" by Powers Fasteners; "AT Acrylic-Tie" by Simpson/Strong-Tie; or accepted equivalent.
 - b. Anchors for use when base material temperature is 40°F or greater: "HIT HY 20" by Hilti; "Epcon C6" by ITW Ramset/Red Head; "Power-Fast" by Powers Fasteners; "ET Epoxy-Tie" by Simpson/Strong-Tie; or accepted equivalent.
 - c. Provide manufacturer's standard screen tubes for use with anchors.

2.2 FABRICATION

- A. Fabricate structural steel in strict accordance with reviewed shop drawings and referenced standards.
- B. Fabricate and assemble structural material in shop to greatest extent possible.
- C. Provide holes for securing other work to structural steel framing. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in base and bearing plates more than 3/4 inch thick.
- G. For beams to be hot-dip galvanized, predrill beam to form radius portion of copes as shown in AISC "Specification Commentary." Do not punch.

- H. Anchor Rods: Furnish anchor rods, leveling plate, or other devices necessary for setting anchoring rods required for securing structural steel to foundation, concrete.
- I. Steel Wall Framing: Select members true and straight for fabrication of steel wall framing and lintels. Straighten as required to provide uniform, square, and true members in completed wall framing. Limit sweep to 1/8 inch for each 10 feet of length.

2.3 SHOP PAINTING

- A. Shop-paint structural steel work that will remain exposed to view in final work or where indicated in drawings. Do not paint members or portions of members to be concealed in final work, embedded in concrete or mortar, or to receive spray-on fireproofing unless noted otherwise in drawings.
- B. Do not paint the following surfaces:
 - 1. Surfaces within 2 inches of field welds.
- C. Apply two coats of paint to surfaces that will be inaccessible after assembly or erection. Apply two coats to surfaces indicated to be cold-galvanized.
- D. For steel to be hot-dip galvanized, prepare steel by successive immersion in chemical baths of caustic cleaning, pickling, and flux.
- E. After surface preparation, immediately apply structural steel primer paint in accordance with manufacturer's instructions at a rate to provide uniform dry-film thickness of 2 mils. Use painting methods that will result in full coverage of joints, corners, edges, and exposed surfaces.

2.4 CONNECTIONS

- A. Comply with requirements of this section unless indicated otherwise in drawings.
- B. Only use connections published by AISC. Do not modify published connection details unless accepted by Engineer.
- C. Use connection dimensions and sizes complying with AISC-published recommendations and limitations.
- D. Weld or bolt shop connections.
- E. Bolt field connections wherever possible.
- F. One-sided or other eccentric connections shall be permitted if shown in drawings or if accepted by Engineer. Only AISC-published connection designs shall be used.
- G. Minimum Capacity of Beam Connections: For connections not detailed, provide connection capacity of reactions shown in drawings. If not shown, base on Load and Resistance Factor Design as follows:
 - 1. At least 50 percent of maximum total factored uniform load from Maximum Total Factored Uniform Load Tables in AISC *LRFD Manual*, Part 5, for given steel member.
 - 2. For beams and girders with shear connectors, provide connection capacity of at least 70 percent of the uniform load values unless indicated otherwise in drawings.
 - 3. Concentrated loads near supports must be added.
- H. Provide unfinished threaded fasteners installed snug-tight for bolted bearing connections of secondary framing members to primary members including girts, door framing systems, and roof openings.

- I. Provide high-strength fasteners for principal bolted connections unless otherwise indicated.
- J. Fabricator shall select and detail connections to properly transmit total reactions, moments, and axial forces either indicated in drawings or reasonably inferred from information provided.
- K. Provide bearing bolt (N) connections for connections unless indicated otherwise.
- L. Remove burrs that prevent solid seating of connected parts.
- M. Load indicator washers not permitted.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Examine conditions under which work shall be erected. Do not proceed until unsatisfactory conditions are corrected.

3.2 ERECTION

- A. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of a complete frame or structure before permanently fastening.
- B. Fit up connections to be field welded in compliance with AWS standard tolerances for review by the Special Inspector or Testing Agency prior to field welding.
- C. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact after assembly.
- D. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure within specified tolerances.
- E. Contractor to field modify anchor rods and embedded structural supports incorrectly located or damaged after installation as indicated in Section 03 30 00 and tested by Testing Agency.
- F. Splice members only where shown or specified.
- G. Maintain work in stable condition during erection.
- H. Use of gas-cutting torches in field to correct fabricating errors is prohibited.
- I. Tighten bearing-bolt (N) connections to snug-tight condition.
- J. Install field connections and framing as detailed in Contract Documents and accepted shop drawings. If Contractor finds field modifications are necessary, submit documentation of proposed field modifications to Architect and Engineer for review and acceptance.

3.3 TOLERANCES

- A. Tolerances shall be within limits in AISC "Code of Standard Practice."
- B. Fabrication and mill tolerance shall be within limits in AISC "Standard Mill Practice."

3.4 TOUCH-UP PAINTING

- A. After erection is complete, touch up paint-damaged shop coats and welded areas with shop primer paint applied in accordance with manufacturer's instructions.
- B. Touch up paint-damaged galvanized surfaces and welded areas with cold-galvanizing paint applied in accordance with manufacturer's instructions.

C. Remove weld slag before applying touch-up paint.

3.5 PROTECTION

A. Do not use members for storage or work platforms until permanently secured.

B. Do not exceed load capacity of members with construction loads.

- - - END - - -

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.
- B. Items specified.
 - 1. Support for Wall Mounted Items
 - 2. Loose Lintels
 - 3. Shelf Angles
 - 4. Plate Door Sill
 - 5. Safety Nosings
 - 6. Ladders
 - 7. Railings

1.2 RELATED WORK

- A. Colors, finishes, and textures: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Prime and finish painting: Section 09 91 00, PAINTING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data for grating specified.
- C. Shop Drawings:
 - 1. Each item specified, showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors.
 - 2. Mark items requiring field assembly for erection identification and furnish erection drawings and instructions.
 - 3. Provide templates and rough-in measurements as required.
- D. Manufacturer's Certificates:
 - 1. Anodized finish as specified.
 - 2. Live load designs as specified.
- E. Design Calculations for specified live loads including dead loads.
- F. Furnish setting drawings and instructions for installation of anchors to be preset into concrete and masonry work, and for the positioning of items having anchors to be built into concrete or masonry construction.

1.4 QUALITY ASSURANCE

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

- B. Each product type shall be the same and be made by the same manufacturer.
- C. Assembled product to the greatest extent possible before delivery to the site.
- D. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
 - B18.2.2-87(R2005).....Square and Hex Nuts
- C. American Society for Testing and Materials (ASTM):
 - A36/A36M-08.....Structural Steel
 - A53-10.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated
Welded and Seamless
 - A123-09.....Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
 - A307-10.....Carbon Steel Bolts and Studs, 60,000 PSI Tensile
Strength
 - A391/A391M-07.....Grade 80 Alloy Steel Chain
 - A653/A653M-10.....Steel Sheet, Zinc Coated (Galvanized) or Zinc-
Iron Alloy Coated (Galvannealed) by the Hot-Dip
Process
 - C1107-08.....Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 - F436-10.....Hardened Steel Washers
 - F468-10.....Nonferrous Bolts, Hex Cap Screws, and Studs for
General Use
 - F593-02(R2008).....Stainless Steel Bolts, Hex Cap Screws, and Studs
 - F1667-11.....Driven Fasteners: Nails, Spikes and Staples
- D. American Welding Society (AWS):
 - D1.1-10.....Structural Welding Code Steel
- E. National Association of Architectural Metal Manufacturers (NAAMM)
 - AMP521-01.....Pipe Railing Manual
 - AMP 500-06.....Metal Finishes Manual
 - MBG 531-09.....Metal Bar Grating Manual
 - MBG 532-09.....Heavy Duty Metal Bar Grating Manual
- F. Structural Steel Painting Council (SSPC):
 - SP 1-04.....No. 1, Solvent Cleaning
 - SP 2-04.....No. 2, Hand Tool Cleaning

SP 3-04.....No. 3, Power Tool Cleaning

G. Federal Specifications (Fed. Spec):

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

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

- A. In addition to the dead loads, design fabrications to support the following live loads unless otherwise specified.
- B. Ladders and Rungs: 250 pounds at any point.
- C. Railings and Handrails: 200 pounds in any direction at any point.
- D. Floor Plates, Gratings and Platforms: 100 pounds per square foot. Use 300 pounds for concentrated loads.

2.2 MATERIALS

- A. Structural Steel: ASTM A36.
- B. Steel Pipe: ASTM A53.
 - 1. Galvanized for exterior locations.
 - 2. Type S, Grade A unless specified otherwise.
 - 3. NPS (inside diameter) as shown.
- C. Primer Paint: As specified in Section 09 91 00, PAINTING.
- D. Grout: ASTM C1107, pourable type.

2.3 HARDWARE

- A. Rough Hardware:
 - 1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electro-galvanizing process. Galvanized G-90 where specified.
 - 2. Use G90 galvanized coating on ferrous metal for exterior work unless non-ferrous metal or stainless is used.
- B. Fasteners:
 - 1. Bolts with Nuts:
 - a. ASME B18.2.2.
 - b. ASTM A307 for 60,000 psi tensile strength bolts.
 - c. ASTM F468 for nonferrous bolts.
 - 2. Screws: ASME B18.6.1.
 - 3. Washers: ASTM F436, type to suit material and anchorage.

2.4 FABRICATION GENERAL

- A. Material
 - 1. Use material as specified. Use material of commercial quality and suitable for intended purpose for material that is not named or its standard of quality not specified.

2. Use material free of defects which could affect the appearance or service ability of the finished product.

B. Size:

1. Size and thickness of members as shown.
2. When size and thickness is not specified or shown for an individual part, use size and thickness not less than that used for the same component on similar standard commercial items or in accordance with established shop methods.

C. Connections

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

D. Fasteners and Anchors

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

E. Workmanship

1. General:

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

- f. Joints firm when assembled.
- g. Conceal joining, fitting and welding on exposed work as far as practical.
- h. Do not show screws prominently on the exposed face.
- i. The fit of components and the alignment of holes shall eliminate the need to modify component or to use exceptional force in the assembly of item and eliminate the need to use other than common tools.

F. Finish:

- 1. Finish exposed surfaces in accordance with NAAMM Metal Finishes Manual.
- 2. Steel and Iron: NAAMM AMP 504.
 - a. Zinc coated (Galvanized): ASTM A123, G90 unless noted otherwise.
 - b. Surfaces exposed in the finished work:
 - 1) Finish smooth rough surfaces and remove projections.
 - 2) Fill holes, dents and similar voids and depressions with epoxy type patching compound.
 - c. Shop Prime Painting:
 - 1) Surfaces of Ferrous metal:
 - a) Items not specified to have other coatings.
 - b) Galvanized surfaces specified to have prime paint.
 - c) Remove all loose mill scale, rust, and paint, by hand or power tool cleaning as defined in SSPC-SP2 and SP3.
 - d) Clean of oil, grease, soil and other detrimental matter by use of solvents or cleaning compounds as defined in SSPC-SP1.
 - e) After cleaning and finishing apply one coat of primer as specified in Section 09 91 00, PAINTING.
 - 2) Non ferrous metals: Comply with MAAMM-500 series.

2.5 SUPPORTS

A. General:

- 1. Fabricate ASTM A36 structural steel shapes as shown.
- 2. Use clip angles or make provisions for welding hangers and braces to overhead construction.
- 3. Field connections may be welded or bolted.

B. For Wall Mounted Items:

- 1. For items supported by metal stud partitions.
- 2. Steel strip or hat channel minimum of 1.5 mm (0.0598 inch) thick.
- 3. Steel strip minimum of 150 mm (6 inches) wide, length extending one stud space beyond end of item supported.

4. Steel hat channels where shown. Flange cut and flatted for anchorage to stud.

2.6 LOOSE LINTELS

- A. Furnish lintels of sizes shown. Where size of lintels is not shown, provide the sizes specified.
- B. Fabricate lintels with not less than 8 inch bearing at each end.
- C. Provide one angle lintel for each 4 inches of masonry thickness as follows except as otherwise specified or shown.
 1. Openings 2-1/2 feet to 6 feet- 4 x 3-1/2 x 5/16 inch.
 2. Openings 6 feet to 10 feet - 6 x 3-1/2 x 3/8 inch.
- D. Provide bearing plates for lintels where shown.
- E. Weld upstanding legs of double angle lintels together at 12 inches on centers.
- F. Galvanize steel members after fabrication in accordance with ASTM A123, G-90.

2.7 SHELF ANGLES

Fabricate from steel angles of size shown

2.8 LADDERS

- A. Steel Ladders:
 1. Fixed-rail type with steel rungs shouldered and headed into and welded to rails.
 2. Fabricate angle brackets as indicated on contract drawings.
- B. Ladder Rungs:

Fabricate from one inch diameter steel bars.
- C. Self-Closing Safety Gate: Self-closing, swinging gate for attaching to platform and mezzanine railings at access openings; finish to match railing finish. "Self-Closing Safety Gate," by FabEnCo, or accepted equivalent.

2.9 RAILINGS

- A. In addition to the dead load design railing assembly to support live load specified.
- B. Fabrication General:
 1. Provide continuous welded joints, dressed smooth and flush.
 2. Standard flush fittings, designed to be welded, may be used.
 3. Exposed threads will not be approved.
 4. Form handrail brackets to size and design shown.
- C. Steel Pipe Railings:
 1. Fabricate of steel pipe with welded joints.
 2. Number and space of rails as shown.

3. Space posts for railings not over 5 feet on centers between end posts.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set work accurately, in alignment and where shown, plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.
- B. Items set into concrete or masonry.
 1. Provide temporary bracing for such items until concrete or masonry is set.
 2. Place in accordance with setting drawings and instructions.
- C. Field weld in accordance with AWS.
 1. Design and finish as specified for shop welding.
 2. Use continuous weld unless specified otherwise.
- D. Install anchoring devices and fasteners as shown and as necessary for securing metal fabrications to building construction as specified. Power actuated drive pins may be used except for removable items and where members would be deformed or substrate damaged by their use.
- E. Spot prime all abraded and damaged areas of zinc coating as specified and all abraded and damaged areas of shop prime coat with same kind of paint used for shop priming.

3.2 INSTALLATION OF SUPPORTS

Anchorage to structure.

1. Secure angles and clips to overhead structural steel by continuous welding unless shown otherwise on contract drawings.
2. Secure supports to concrete by bolting, continuous welding or as shown on contract drawings.
3. Secure supports to mid height of concrete beams when inserts do not exist with expansion bolts and to slabs, with expansion bolts. unless shown otherwise.
4. Secure steel plate or hat channels to studs as detailed.

3.3 STEEL LINTELS

- A. Use lintel sizes and combinations shown or specified.
- B. Install lintels with longest leg upstanding.
- C. Install lintels to have not less than 8 inch bearing at each end.

3.4 LADDERS

Anchor ladders to floor with expansion bolts through angle clips or brackets.

3.5 RAILINGS

A. Steel Posts:

Secure posts to steel with welds or as shown on contract drawings.

B. Chains:

1. Eye bolt chains to pipe posts.

3.6 CLEAN AND ADJUSTING

A. Adjust movable parts including hardware to operate as designed without binding or deformation of the members centered in the opening or frame and, where applicable, contact surfaces fit tight and even without forcing or warping the components.

B. Clean after installation exposed prefinished and plated items, as recommended by the metal manufacture and protected from damage until completion of the project.

- - - E N D - - -

**SECTION 06 10 00
ROUGH CARPENTRY**

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies wood blocking, framing, sheathing, furring, nailers, sub-flooring, rough hardware, and light wood construction.

1.2 RELATED WORK:

- A. Milled woodwork: Section 06 20 00, FINISH CARPENTRY.
- B. Gypsum sheathing: Section 09 29 00, GYPSUM BOARD.
- C. Cement board sheathing: Section 06 16 63, CEMENTITIOUS SHEATHING.

1.3 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings showing framing connection details, fasteners, connections and dimensions.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Protect lumber and other products from dampness both during and after delivery at site.
- B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.
- C. Stack plywood and other board products so as to prevent warping.
- D. Locate stacks on well drained areas, supported at least 150 mm (6 inches) above grade and cover with well ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

1.5 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.
- B. American Forest and Paper Association (AFPA):
National Design Specification for Wood Construction
NDS-05.....Conventional Wood Frame Construction
- C. American Institute of Timber Construction (AITC):
A190.1-07.....Structural Glued Laminated Timber
- D. American Society of Mechanical Engineers (ASME):
B18.2.1-96(R2005).....Square and Hex Bolts and Screws
B18.2.2-87.....Square and Hex Nuts
B18.6.1-97.....Wood Screws

- B18.6.4-98(R2005).....Thread Forming and Thread Cutting Tapping Screws
and Metallic Drive Screws
- E. American Plywood Association (APA):
E30-07.....Engineered Wood Construction Guide
- F. American Society for Testing And Materials (ASTM):
A47-99(R2009).....Ferritic Malleable Iron Castings
A48-03(R2008).....Gray Iron Castings
A653/A653M-10.....Steel Sheet Zinc-Coated (Galvanized) or Zinc-
Iron Alloy Coated (Galvannealed) by the Hot Dip
Process
C954-10.....Steel Drill Screws for the Application of Gypsum
Board or Metal Plaster Bases to Steel Studs from
0.033 inch (2.24 mm) to 0.112-inch (2.84 mm) in
thickness
C1002-07.....Steel Self-Piercing Tapping Screws for the
Application of Gypsum Panel Products or Metal
Plaster Bases to Wood Studs or Metal Studs
D143-09.....Small Clear Specimens of Timber, Method of
Testing
D1760-01.....Pressure Treatment of Timber Products
D2559-10.....Adhesives for Structural Laminated Wood Products
for Use Under Exterior (Wet Use) Exposure
Conditions
D3498-11.....Adhesives for Field-Gluing Plywood to Lumber
Framing for Floor Systems
F844-07.....Washers, Steel, Plan (Flat) Unhardened for
General Use
F1667-08.....Nails, Spikes, and Staples
- G. Federal Specifications (Fed. Spec.):
MM-L-736C.....Lumber; Hardwood
- H. Commercial Item Description (CID):
A-A-55615.....Shield, Expansion (Wood Screw and Lag Bolt Self
Threading Anchors)
- I. Military Specification (Mil. Spec.):
MIL-L-19140E.....Lumber and Plywood, Fire-Retardant Treated
- J. Truss Plate Institute (TPI):
TPI-85.....Metal Plate Connected Wood Trusses
- K. U.S. Department of Commerce Product Standard (PS)
PS 1-95.....Construction and Industrial Plywood
PS 20-05.....American Softwood Lumber Standard

PART 2 - PRODUCTS**2.1 LUMBER:**

- A. Unless otherwise specified, each piece of lumber bear grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.
 - 1. Identifying marks in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
 - 2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.
- B. Structural Members: Species and grade as listed in the AFPA, National Design Specification for Wood Construction having design stresses as shown.
- C. Lumber Other Than Structural:
 - 1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
 - 2. Framing lumber: Minimum extreme fiber stress in bending of 1100.
 - 3. Furring, blocking, nailers and similar items 100 mm (4 inches) and narrower Standard Grade; and, members 150 mm (6 inches) and wider, Number 2 Grade.
- D. Sizes:
 - 1. Conforming to Prod. Std., PS20.
 - 2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.
- E. Moisture Content:
 - 1. At time of delivery and maintained at the site.
 - 2. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.
 - 3. Lumber over 50 mm (2 inches) thick: 25 percent or less.
- F. Fire Retardant Treatment:
 - 1. Mil Spec. MIL-L-19140 with piece of treated material bearing identification of testing agency and showing performance rating.
 - 2. Treatment and performance inspection, by an independent and qualified testing agency that establishes performance ratings.
- G. Preservative Treatment:
 - 1. Do not treat Heart Redwood and Western Red Cedar.

2. Treat wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including framing of open roofed structures; sills, sole plates, furring, and sleepers that are less than 600 mm (24 inches) from ground; nailers, edge strips, blocking, crickets, curbs, cant, vent strips and other members used in connection with roofing and flashing materials.
3. Treat other members specified as preservative treated (PT).
4. Preservative treat by the pressure method complying with ASTM D1760, except any process involving the use of Chromated Copper arsenate (CCA) for pressure treating wood is not permitted.

2.2 PLYWOOD

- A. Comply with Prod. Std., PS 1.
- B. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.
- C. Sheathing:
 1. APA rated Exposure 1 or Exterior; panel grade CD or better.
 2. Wall sheathing:
 - a. Minimum 9 mm (11/32 inch) thick with supports 400 mm (16 inches) on center and 12 mm (15/32 inch) thick with supports 600 mm (24 inches) on center unless specified otherwise.
 - b. Minimum 1200 mm (48 inches) wide at corners without corner bracing of framing.

2.3 NOT USED.

2.4 ROUGH HARDWARE AND ADHESIVES:

- A. Anchor Bolts:
 1. ASME B18.2.1 and ANSI B18.2.2 galvanized, 13 mm (1/2 inch) unless shown otherwise.
 2. Extend at least 200 mm (8 inches) into masonry or concrete with ends bent 50 mm (2 inches).
- B. Miscellaneous Bolts: Expansion Bolts: C1D, A-A-55615; lag bolt, long enough to extend at least 65 mm (2-1/2 inches) into masonry or concrete. Use 13 mm (1/2 inch) bolt unless shown otherwise.
- C. Washers
 1. ASTM F844.
 2. Use zinc or cadmium coated steel or cast iron for washers exposed to weather.

D. Screws:

1. Wood to Wood: ANSI B18.6.1 or ASTM C1002.
2. Wood to Steel: ASTM C954, or ASTM C1002.

E. Nails:

1. Size and type best suited for purpose unless noted otherwise. Use aluminum-alloy nails, plated nails, or zinc-coated nails, for nailing wood work exposed to weather and on roof blocking.
2. ASTM F1667:
 - a. Common: Type I, Style 10.
 - b. Concrete: Type I, Style 11.
 - c. Barbed: Type I, Style 26.
 - d. Underlayment: Type I, Style 25.
 - e. Masonry: Type I, Style 27.
 - f. Use special nails designed for use with ties, strap anchors, framing connectors, joists hangers, and similar items. Nails not less than 32 mm (1-1/4 inches) long, 8d and deformed or annular ring shank.

F. Framing and Timber Connectors:

1. Fabricate of ASTM A446, Grade A; steel sheet not less than 1.3 mm (0.052 inch) thick unless specified otherwise. Apply standard plating to steel timber connectors after punching, forming and assembly of parts.
2. Framing Angles: Angle designed with bendable legs to provide three way anchors.
3. Straps:
 - a. Designed to provide wind and seismic ties with sizes as shown or specified.
 - b. Strap ties not less than 32 mm (1-1/4 inches) wide.
 - c. Punched for fastener.
4. Metal Bridging:
 - a. Optional to wood bridging.
 - b. V shape deformed strap with not less than 2 nail holes at ends, designed to nail to top and side of framing member and bottom and side of opposite member.
 - c. Not less than 19 mm by 125 mm (3/4 by 5 inches) bendable nailing flange on ends.
 - d. Fabricated of 1 mm (0.04 inch) minimum thick sheet.
5. Joist Hangers:
 - a. Fabricated of 1.6 mm (0.063 inch) minimum thick sheet, U design unless shown otherwise.

- b. Heavy duty hangers fabricated of minimum 2.7 mm (0.108 inch) thick sheet, U design with bent top flange to lap over beam.
- 6. Timber Connectors: Fabricated of steel to shapes shown.
- 7. Joist Ties: Mild steel flats, 5 by 32 mm (3/16 by 1-1/4 inch size with ends bent about 30 degrees from horizontal, and extending at least 400 mm (16 inches) onto framing. Punch each end for three spikes.
- 8. Wall Anchors for Joists and Rafters:
 - a. Mild steel strap, 5 by 32 mm (3/16 by 1-1/4 inch) with wall ends bent 50 mm (2 inches), or provide 9 by 130 mm (3/8 by 5 inch) pin through strap end built into masonry.
 - b. Strap long enough to extend onto three joists or rafters, and punched for spiking at each bearing.
 - c. Strap not less than 100 mm (4 inches) embedded end.
- 9. Joint Plates:
 - a. Steel plate punched for nails.
 - b. Steel plates formed with teeth or prongs for mechanically clamping plates to wood.
 - c. Size for axial eccentricity, and fastener loads.
- G. Adhesives:
 - 1. For field-gluing plywood to lumber framing floor or roof systems: ASTM D3498.
 - 2. For structural laminated Wood: ASTM D2559.

PART 3 - EXECUTION

3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS:

- A. Conform to applicable requirements of the following:
 - 1. AFPA National Design Specification for Wood Construction for timber connectors.
 - 2. AITC Timber Construction Manual for heavy timber construction.
 - 3. AFPA WCD-number 1, Manual for House Framing for nailing and framing unless specified otherwise.
 - 4. APA for installation of plywood or structural use panels.
 - 5. ASTM F 499 for wood underlayment.
 - 6. TPI for metal plate connected wood trusses.
- B. Fasteners:
 - 1. Nails.
 - a. Nail in accordance with the Recommended Nailing Schedule as specified in AFPA Manual for House Framing where detailed nailing requirements are not specified in nailing schedule. Select nail size and nail spacing sufficient to develop adequate strength for the connection without splitting the members.

- b. Use special nails with framing connectors.
- c. For sheathing and subflooring, select length of nails sufficient to extend 25 mm (1 inch) into supports.
- d. Use eight penny or larger nails for nailing through 25 mm (1 inch) thick lumber and for toe nailing 50 mm (2 inch) thick lumber.
- e. Use 16 penny or larger nails for nailing through 50 mm (2 inch) thick lumber.
- f. Select the size and number of nails in accordance with the Nailing Schedule except for special nails with framing anchors.
- g. Nailing Schedule; Using Common Nails:
 - 1) Joist bearing on sill or girder, toe nail three-8d or framing anchor
 - 2) Bridging to joist, toe nail each end two-8d
 - 3) Ledger strip to beam or girder three-16d under each joint.
 - 4) Subflooring or Sheathing:
 - a) 150 mm (6 inch) wide or less to each joist face nail two-8d.
 - b) Subflooring, more than 150 mm (6 inches) wide, to each stud or joint, face nail three-8d.
 - c) Plywood or structural use panel to each stud or joist face nail 8d, at supported edges 150 mm (6 inches) on center and at intermediate supports 250 mm (10 inches) on center. When gluing plywood to joint framing increase nail spacing to 300 mm (12 inches) at supported edges and 500 mm (20 inches) o.c. at intermediate supports.
 - 5) Sole plate to joist or blocking, through sub floor face nail 20d nails, 400 mm (16 inches) on center.
 - 6) Top plate to stud, end nail two-16d.
 - 7) Stud to sole plate, toe nail or framing anchor. Four-8d
 - 8) Doubled studs, face nail 16d at 600 mm (24 inches) on center.
 - 9) Built-up corner studs 16d at 600 mm (24 inches) (24 inches) on center.
 - 10) Doubled top plates, face nails 16d at 400 mm (16 inches) on center.
 - 11) Top plates, laps, and intersections, face nail two-16d.
 - 12) Continuous header, two pieces 16d at 400 mm (16 inches) on center along each edge.
 - 13) Ceiling joists to plate, toenail three-8d or framing anchor.
 - 14) Continuous header to stud, four 16d.
 - 15) Ceiling joists, laps over partitions, face nail three-16d or framing anchor.
 - 16) Ceiling joists, to parallel rafters, face nail three-16d.

- 17) Rafter to plate, toe nail three-8d. or framing anchor. Brace 25 mm (1 inch) thick board to each stud and plate, face nail three-8d.
- 18) Built-up girders and beams 20d at 800 mm (32 inches) on center along each edge.

SPEC WRITER NOTE: Do not fasten to bottom flange of steel beams.

2. Bolts:
 - a. Fit bolt heads and nuts bearing on wood with washers.
 - b. Countersink bolt heads flush with the surface of nailers.
 - c. Embed in concrete and solid masonry or use expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
 - d. Use toggle bolts to hollow masonry or sheet metal.
 - e. Use bolts to steel over 2.84 mm (0.112 inch, 11 gage) in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 600 mm (24 inch) intervals between end bolts. Use clips to beam flanges.
3. Drill Screws to steel less than 2.84 mm (0.112 inch) thick.
 - a. ASTM C1002 for steel less than 0.84 mm (0.033 inch) thick.
 - b. ASTM C 954 for steel over 0.84 mm (0.033 inch) thick.
4. Power actuated drive pins may be used where practical to anchor to solid masonry, concrete, or steel.
5. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Use metal plugs, inserts or similar fastening.
6. Screws to Join Wood:
 - a. Where shown or option to nails.
 - b. ASTM C1002, sized to provide not less than 25 mm (1 inch) penetration into anchorage member.
 - c. Spaced same as nails.
7. Installation of Timber Connectors:
 - a. Conform to applicable requirements of the NFPA National Design Specification for Wood Construction.
 - b. Fit wood to connectors and drill holes for fasteners so wood is not split.
- C. Set sills or plates level in full bed of mortar on masonry or concrete walls.
 1. Space anchor bolts 1200 mm (4 feet) on centers between ends and within 150 mm (6 inches) of end. Stagger bolts from side to side on plates over 175 mm (7 inches) in width.

2. Use shims of slate, tile or similar approved material to level wood members resting on concrete or masonry. Do not use wood shims or wedges.
 3. Closely fit, and set to required lines.
- D. Cut notch, or bore in accordance with NFPA Manual for House-Framing for passage of ducts wires, bolts, pipes, conduits and to accommodate other work. Repair or replace miscut, misfit or damaged work.
- E. Blocking Nailers, and Furring:
1. Install furring, blocking, nailers, and grounds where shown.
 2. Use longest lengths practicable.
 3. Use fire retardant treated wood blocking where shown at openings and where shown or specified.
 4. Layers of Blocking or Plates:
 - a. Stagger end joints between upper and lower pieces.
 - b. Nail at ends and not over 600 mm (24 inches) between ends.
 - c. Stagger nails from side to side of wood member over 125 mm (5 inches) in width.
 5. Not Used.
 6. Unless otherwise shown, use wall furring 25 mm by 75 mm (1 inch by 3 inch) continuous wood strips installed plumb on walls, using wood shims where necessary so face of furring forms a true, even plane. Space furring not over 400 mm (16 inches on centers, butt joints over bearings and rigidly secure in place. Anchor furring on 400 mm (16 inches) centers.
- F. Not Used.
- G. Not Used.
- H. Not Used.
- I. Not Used.
- J. Partition and Wall Framing:
1. Use 50 mm by 100 mm (2 inch by 4 inch) studs spaced 400 mm (16 inches) on centers; unless shown otherwise.
 2. Install double studs at openings and triple studs at corners.
 3. Installation of sole plate:
 - a. Anchor plates of walls or partitions resting on concrete floors in place with expansion bolts, one near ends of piece and at intermediate intervals of not more than 1200 mm (4 feet) or with power actuated drive pins with threaded ends of suitable type and size, spaced 600 mm (2 feet) on center unless shown otherwise.

- b. Nail plates to wood framing through subfloor as specified in nailing schedule.
4. Headers or Lintels:
- a. Make headers for openings of two pieces of 50 mm (2 inch) thick lumber of size shown with plywood filler to finish flush with face of studs or solid lumber of equivalent size.
 - b. Support ends of headers on top of stud cut for height of opening. Spike cut stud to adjacent stud. Spike adjacent stud to header.
5. Use double top plates, with members lapped at least 610 mm (2-feet) spiked together.
6. Install intermediate cut studs over headers and under sills to maintain uniformity of stud spacing.
7. Use single sill plates at bottom of opening unless shown otherwise. Toe nail to end stud, face nail to intermediate studs.
8. Install 50 mm (2 inch) blocking for firestopping so that maximum dimension of any concealed space is not over 2400mm (8 feet) in accordance with NFPA Manual for House Framing.
9. Install corner bracing when plywood or structured use panel sheathing is not used.
- a. Let corner bracing into exterior surfaces of studs at an angle of approximately 45 degrees, extended completely over walls plates, and secured at bearing with two nails.
 - b. Use 25 mm by 100 mm (1 inch by 4 inch) corner bracing.
- K. Rough Bucks:
- 1. Install rough wood bucks at opening in masonry or concrete where wood frames or trim occur.
 - 2. Brace and maintain bucks plumb and true until masonry has been built around them or concrete cast in place.
 - 3. Cut rough bucks from 50 mm (2 inch) thick stock, of same width as partitions in which they occur and of width shown in exterior walls.
 - 4. Extend bucks full height of openings and across head of openings; fasten securely with anchors specified.
- L. Not Used.
- M. Not Used.
- N. Sheathing:
- 1. Use plywood or structural-use panels for sheathing.
 - 2. Lay panels with joints staggered, with edge and ends 3 mm (1/8 inch) apart and nailed over bearings as specified.
 - 3. Set nails not less than 9 mm (3/8 inch) from edges.

4. Install 50 mm by 100 mm (2 inch by 4 inch) blocking spiked between joists, rafters and studs to support edge or end joints of panels.
5. Match and align sheathing which is an extension of work in place to existing.

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SECTION 07 13 52
MODIFIED BITUMINOUS SHEET WATERPROOFING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies modified bituminous sheet material used for exterior below grade waterproofing and split slab waterproofing.

1.2 MANUFACTURER'S QUALIFICATIONS:

- A. Approval by Contracting Officer is required of products and services of proposed manufacturers, and installers, and will be based upon submission by Contractor that:
1. Manufacturer regularly and presently manufactures bituminous sheet waterproofing as one of its principal products.
 2. Installer has technical qualifications, experience, trained personnel and facilities to install specified items.
 3. Manufacturer's product submitted has been in satisfactory and efficient operation on three similar installations for at least three years.
 4. Submit list of installations, include name and location of project and name of owner.

1.3 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
1. Bituminous sheet.
 2. Primer.
 3. Mastic.
 4. Protection material, temporary and permanent.
 5. Printed installation instructions for conditions specified.
- C. Certificates:
1. Indicating bituminous sheet manufacturer's approval of primer, and roof cement.
 2. Indicating bituminous sheet waterproofing manufacturer's qualifications as specified.
 3. Approval of installer by bituminous sheet manufacturers.
 4. Water test report.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver materials to job in manufacturer's original unopened container.

- B. Do not store material in areas where temperature is lower than 10 degrees C (50 degrees F,) or where prolonged temperature is above 32 degrees C (90 degrees F).

1.5 ENVIRONMENTAL REQUIREMENTS:

Ambient Surface and Material Temperature: Not less than 4 degrees C (40 degrees F), during application of waterproofing.

1.6 WARRANTY:

Warrant bituminous sheet waterproofing installation against moisture leaks and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period is two years.

1.7 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by basic designation only.
- B. Federal Specifications (Fed. Spec.):
 UU-B-790A.....Building Paper, Vegetable Fiber: (Kraft, Water-INT AMD 1 Proof, Water Repellent and Fire Resistant)
- C. American Society for Testing and Materials (ASTM):
 C578-10.....Rigid Cellular Polystyrene Thermal Insulation
 D41-11.....Asphalt Primer Used in Roofing, Dampproofing and Waterproofing
 D2822-05.....Asphalt Roof Cement
 D6380-03(R2009).....Asphalt Roll Roofing (Organic Felt)
- D. American Hardboard Association (AHA):
 A135.4-1995.....Basic Hardboard

PART 2 - PRODUCTS

2.1 BITUMINOUS SHEET:

- A. Cold applied waterproofing membrane composed primarily of modified bituminous material prefabricated in sheet form designed for below grade exterior and split slab waterproofing. Sheet reinforced with fibers at manufacturer's option.
- B. Thickness of Bituminous Sheet: 1.5 mm (60 mils), plus or minus 0.13 mm (5 mils), and bonded to a 0.1 mm (4 mil) thick plastic sheet.
- C. Provide with a release sheet to prevent bonding of bituminous sheet to itself.

2.2 PRIMER:

- A. Furnished by manufacturer of bituminous sheet as required for particular application in accordance with sheet manufacturer's instructions.
- B. Primer: ASTM D41.

2.3 PROTECTION MATERIAL:

- A. Polystyrene: ASTM C578, Type I or VIII, 13 mm (1/2-inch) minimum thickness.
- B. Hardboard: PS-58, Service Type, 6 mm (1/4-inch) thick.
- C. Waterproofed Building Paper: Fed. Spec. UU-B-790.

2.4 PATCHING COMPOUND:

- A. A factory prepared, non-shrinking, fast setting, cementitious adhesive compound containing no ferrous metal or oxide.
- B. Waterproofing manufacturer supplied low-viscosity asphalt-modified coating.

2.5 MISCELLANEOUS MATERILAS:

- A. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 25 mm (1 inch) wide, prepunched, with zinc- alloy-body fasteners and stainless-steel pins.

PART 3 - EXECUTION**3.1 PREPARATION:**

- A. Surface Condition:
 - 1. Before applying waterproofing materials, ensure concrete and masonry surfaces are fully cured, smooth, clean, dry, and free from high spots, depressions, loose and foreign particles and other deterrents to adhesion.
 - 2. Fill voids, joints, and cracks with patching compound.
- B. Concrete surfaces cured a minimum of seven days, free from release agents, concrete curing agents, and other contaminates.

3.2 APPLICATION:

- A. Priming:
 - 1. Prime concrete and masonry surfaces.
 - 2. Application method, amount of primer and condition or primer before installation of bituminous sheet as recommended by primer manufacturer.
 - 3. Reprime when required in accordance with manufacturer's instructions.

B. Bituminous Sheet Installation:

1. Remove release sheet prior to application.
2. Lay bituminous sheet from low point to high point so that laps shed water.
3. Treat expansion, construction and control joints and evident working cracks as expansion joints. Apply bituminous sheet in double thickness over joint by first applying a strip of bituminous sheet not less than 200 mm (8 inches) wide, centered over joint.
4. Lap seams not less than 50 mm (2 inches).
5. Lay succeeding sheet with laps, and roll or press into place.
6. Repair misaligned or inadequately lapped seams in accordance with manufacturer's instructions.
7. Seal seams and terminations in accordance with sheet manufacturer's instructions.

C. Corner Treatment:

1. At inside and outside corners apply double cover using an initial strip not less than 280 mm (11 inches) wide, centered along axis of corner.
2. Cover each strip completely by the regular application of bituminous sheet.
3. Provide a fillet or cant on inside corners.
4. Form cants using patching compound
5. Do not use wood, fiber, and insulating materials for cants.

D. Projection Treatment:

1. Apply a double layer of bituminous sheet around pipes and similar projections at least 150 mm (6 inches) wide.
2. At drains, apply a bead of roof cement over a double layer of bituminous sheet under clamping rings.

3.3 PROTECTION:

- A. Protect bituminous sheet before backfill or wearing courses are placed.
- B. Install protection material and hold in place in accordance with instructions of manufacturer of waterproofing materials.
- C. Permanent Protection:
 1. Vertical Surfaces:
 - a. Install hardboard, polystyrene, or roll roofing protection material.
 - b. Extend protection full height from footing to top of backfill.
 - c. If graded backfill is used, use roll roofing or hardboard.

D. Horizontal Surfaces:

1. Install roll roofing protection under concrete wearing courses.
2. Install roll roofing, hardboard, or polystyrene under earth backfill.
3. Where no concrete wearing course occurs or when surfaces will bear heavy traffic and will not immediately be covered with a wearing course, use protection specified for vertical surfaces.

E. Temporary Protection:

When waterproofing materials are subjected to damage by sunlight and can not be immediately protected as specified, protect waterproofing materials by waterproof building paper or suitable coating approved by manufacturer of waterproofing system used.

3.4 PATCHING:

Repair tears, punctures, air blisters, and inadequately lapped seams, in accordance with manufacturer's instructions before protection course is applied.

3.5 TESTING:

- A. Before any protection or wearing course is applied, test all horizontal applications of waterproofing with a minimum of 25 mm (1-inch) head of water above highest point and leave for 24 hours.
- B. Mark leaks and repair when waterproofing is dry.
- C. Certify, to COR, that water tests have been made and that areas tested were found watertight.

3.6 INSPECTION:

Do not cover waterproofed surfaces by other materials or backfill until work is approved by COR.

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**SECTION 07 17 13
BENTONITE WATERPROOFING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The general provision of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

The extent of Geotextile/Bentonite Clay waterproofing membrane is shown on the drawing.

1.3 RELATED SECTIONS

- A. Division 03 - Concrete
- B. Division 31 - Earthwork

1.4 QUALITY ASSURANCE

- A. Manufacturer: Provide Geotextile/Bentonite Clay waterproofing membrane produced by a manufacturer with a minimum of 5 years experience in the waterproofing industry.
- B. Installer: A firm with a minimum of 2 years experience in installing bentonite clay or other related waterproofing products.

1.5 SUBMITTALS

- A. Manufacturer: Submit six copies of product data sheets, specifications, installation instructions and general recommendations for each type of product specified.
- B. Installer: Submit detail drawings for installation of product specified.
- C. Water Sample Test Result: A water sample (2 liters) is required on projects that have ground water and should be submitted to the waterproofing manufacturer to test for contamination and compatibility with waterproofing membrane. Submit to architect a letter of compatibility recommending which formulation to use.
- D. Warranty: Manufacturers' standard warranty 5 year material warranty.

1.6 WARRANTY

- A. Upon completion and acceptance of the work required by this section, the manufacturer will issue a warranty agreeing to promptly replace defective materials for a period of 5 years.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original manufacturer's packaging and store materials in strict accordance with manufacturer's instructions.
- B. Remove and replace products that have been prematurely exposed to moisture.

1.8 PROJECT CONDITIONS

- A. Install materials in accordance with all safety and weather conditions required by the manufacturer.
- B. Install materials only after work on the applicable substrate is complete.

PART 2 - PRODUCTS

2.1 WATERPROOFING SYSTEM

- A. The Geotextile/Bentonite clay waterproofing membrane basis of design is CCW MiraCLAY supplied by Carlisle Coatings & Waterproofing Incorporated
- B. Physical Properties for Geotextile/Bentonite Clay Waterproofing Membrane:

CCW MiraCLAY Physical Properties:

Property	Test Method	Value
Bentonite Content	-	1.0 lb/ft ² (.488 kg/m ²)*
Nominal Dry Thickness	-	0.25 in (6.4 mm)
Weight	-	75 lb (34.05 kg)
Permeability	ASTM D 5084	5 x 10 ⁻⁹ cm/sec
Grab Tensile Strength	ASTM D 4632	95 lb (422 N)
Grab Elongation	ASTM D 4632	150%
Puncture Resistance	ASTM D 4833	120 psi (828 kPa)
Hydrated Internal Shear	ASTM D 5321	500 psf (24 kPa)
Swell Index	ASTM D 5890	2g (24 ml) min.
Fluid Loss	ASTM D 5891	18 ml max.
Dimensions		5 ft x 14 ft (70 ft ²)
Hydrostatic Head Pressure (69.49 meter)		ASTM D751 228 ft
Adhesion to Concrete	ASTM D903	17.7 lb/in (8 kg/cm)

*@ 12% moisture content

- C. Waterproofing system accessories supplied by waterproofing membrane manufacturer:
Mastic: Mastic is used for detailing at terminations and penetrations. Also used to fill minor voids in concrete and as a fillet in angle changes.
Granules: Granules used for horizontal to vertical transitions and for detailing at seams and slab penetrations.

- Waterstop: Waterstop is used at cold concrete pours and between pre-cast concrete panels.
- D. Membrane to Substrate Fasteners: Fasteners, of the type and length suitable for the substrate, shall be used in conjunction with washers, of at least 1" diameter to attach the geotextile/bentonite clay waterproofing membrane to the substrate.
 - E. Membrane to Membrane Fasteners: Mechanically fasten membrane sheets together with a box stapler or similar device for horizontal applications.
 - F. The Geotextile/Bentonite membrane shall consist of geotextile panels of sodium bentonite clay sandwiched between two layers of needle-punched woven and non-woven polypropylene fabrics.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine substrate and condition under which waterproofing will be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Grade Substrates: Shall be level and uniform that is compacted to a minimum of 85% modified proctor.
- B. Concrete Application:
 - 1. Apply mastic to all construction joints at a minimum of 1/4" (7 mm) thickness and a 3" (8 cm) minimum width.
 - 2. Remove projections from the wall surface in excess of 3/4" (20 mm).
- C. Honeycombing, voids and aggregate pockets exceeding 1" in diameter or have a depth greater than 3/4" should be filled with a non-shrink cementitious grout. Fill tie-rod holes with a non-shrink cementitious grout.

3.3 INSTALLATION

- A. Prevent geotextile/bentonite clay waterproofing membrane from hydrating before being covered with overburden. When threat of rain is imminent or backfill is not immediate, geotextile/bentonite clay waterproofing membrane should be covered with polyethylene sheeting.
- B. Underslab Application:
 - 1. See drawings for installation details.
 - 2. Staple joints often enough to prevent excessive movement.
 - 3. Pour granules or trowel mastic around all penetrations and press in "cut-to-fit" collars of bentonite system.
 - 4. Inspect and repair any damaged material before concrete pour or placement of precast.

3.4 PROTECTION AND DRAINAGE

1. Provide drainage per drawings and Modified Bituminous Sheet Waterproofing specification section.

3.5 BACKFILL

1. **Backfill per Structural Excavation, Backfill & Compaction specification.**

SECTION 07 21 13

THERMAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 RELATED WORK

- A. Insulating concrete systems: Section 03 52 00, LIGHTWEIGHT CONCRETE ROOF INSULATION.
- B. Not Used.
- C. Insulation in connection with roofing and waterproofing: Section 07 22 00, ROOF AND DECK INSULATION.
- D. Not Used.
- E. Safing insulation: Section 07 84 00, FIRESTOPPING.

1.3 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Insulation, each type used
 - 2. Adhesive, each type used.
 - 3. Tape
- C. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.4 STORAGE AND HANDLING:

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

1.5 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C270-10.....Mortar for Unit Masonry
 - C516-08.....Vermiculite Loose Fill Thermal Insulation
 - C549-06.....Perlite Loose Fill Insulation

C552-07.....Cellular Glass Thermal Insulation.

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

C578-10.....Rigid, Cellular Polystyrene Thermal Insulation

C591-09.....Unfaced Preformed Rigid Cellular
Polyisocyanurate Thermal Insulation

C612-10.....Mineral Fiber Block and Board Thermal
Insulation

C665-06.....Mineral Fiber Blanket Thermal Insulation for
Light Frame Construction and Manufactured
Housing

C728-05 (R2010).....Perlite Thermal Insulation Board

C954-10.....Steel Drill Screws for the Application of
Gypsum Panel Products or Metal Plaster Base to
Steel Studs From 0.033 (0.84 mm) inch to 0.112
inch (2.84 mm) in thickness

C1002-07.....Steel Self-Piercing Tapping Screws for the
Application of Gypsum Panel Products or Metal
Plaster Bases to Wood Studs or Steel Studs

D312-00(R2006).....Asphalt Used in Roofing

E84-10.....Surface Burning Characteristics of Building
Materials

F1667-11.....Driven Fasteners: Nails, Spikes and Staples.

PART 2 - PRODUCTS

2.1 INSULATION - GENERAL:

- A. Where 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.
- D. Insulation Products shall comply with following minimum content standards for recovered materials:

Material Type	Percent by Weight
Perlite composite board	23 percent post consumer recovered paper
Polyisocyanurate/polyurethane	
Rigid foam	9 percent recovered material
Foam-in-place	5 percent recovered material
Glass fiber reinforced	6 percent recovered material
Phenolic rigid foam	5 percent recovered material
Rock wool material	75 percent recovered material

The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

2.2 MASONRY CAVITY WALL INSULATION:

- A. Mineral Fiber Board: ASTM C612, Type II, faced with a vapor retarder having a perm rating of not more than 0.5.
- B. Polyurethane or Polyisocyanurate Board: ASTM C591, Type I, faced with a vapor retarder having a perm rating of not more than 0.5.
- C. Polystyrene Board: ASTM C578, Type X.
- D. Perlite Board: ASTM C728.
- E. Cellular Glass Block: ASTM C552, Type I or IV.

2.3 PERIMETER INSULATION IN CONTACT WITH SOIL:

- A. Polystyrene Board: ASTM C578, Type IV, V, VI, VII, or IX where covered by soil or concrete.
- B. Cellular Glass Block: ASTM C552, Type I or IV.

2.4 EXTERIOR FRAMING OR FURRING INSULATION:

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

2.5 ACOUSTICAL INSULATION:

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

2.6 SOUND DEADENING BOARD:

- A. Mineral Fiber Board: ASTM C612, Type IB, 13 mm (1/2 inch thick).
- B. Perlite Board: ASTM C728, 13 mm (1/2 inch thick).

2.7 RIGID INSULATION:

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

2.8 MASONRY FILL INSULATION:

- A. Vermiculite Insulation: ASTM C516, Type II.
- B. Perlite Insulation: ASTM C549, Type IV.

2.9 FASTENERS:

- A. Staples or Nails: ASTM F1667, zinc-coated, size and type best suited for purpose.
- B. Screws: ASTM C954 or C1002, size and length best suited for purpose with washer not less than 50 mm (two inches) in diameter.
- C. Impaling Pins: Steel pins with head not less than 50 mm (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.

2.10 ADHESIVE:

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

2.11 TAPE:

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

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

- A. Install 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 MASONRY CAVITY WALLS:

- A. Mount insulation on exterior faces of inner wythes of masonry cavity walls and brick faced concrete walls. Fill joints with same material used for bonding.
- B. Bond polystyrene board to surfaces with adhesive or Portland cement mortar mixed and applied in accordance with recommendations of insulation manufacturer.
- C. Bond mineral fiberboard, polyurethane or polyisocyanurate board, and perlite board to surfaces with adhesive as recommended by insulation manufacturer.
- D. Bond cellular glass insulation to surfaces with hot asphalt or adhesive cement.

3.3 PERIMETER INSULATION:

- A. Vertical insulation:
 - 1. Fill joints of insulation with same material used for bonding.
 - 2. Bond polystyrene board to surfaces with adhesive or Portland cement mortar mixed and applied in accordance with recommendations of insulation manufacturer.
 - 3. Bond cellular glass insulation to surfaces with hot asphalt or adhesive cement.
- B. Horizontal insulation under concrete floor slab:
 - 1. Lay insulation boards and blocks horizontally on level, compacted and drained fill.
 - 2. Extend insulation from foundation walls towards center of building not less than 600 mm (24 inches) or as shown.

3.4 EXTERIOR FRAMING OR FURRING BLANKET INSULATION:

- A. Pack insulation around door frames and windows and in building expansion joints, door soffits and other voids. Pack behind outlets around pipes, ducts, and services encased in walls. 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 150 mm (six inches) apart.
- E. Roof Rafter Insulation or Floor Joist Insulation: Place mineral fiber blankets between framing to provide not less than a 50 mm (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.

3.5 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 300 mm (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 11.5 Kg per m² (25 lbs/100 sq. ft.), 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 11.5 Kg per m² per m² lbs/100 sq. ft.).
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.

3.6 MASONRY FILL INSULATION:

- A. Pour fill insulation in cavity/ voids of masonry units from tops of walls, or from sill where windows or other openings occur.
- B. Pour in lifts of not more than 6 m (20 feet).

3.7 ACOUSTICAL INSULATION:

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

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SECTION 07 27 26
FLUID-APPLIED MEMBRANE AIR BARRIERS, VAPOR PERMEABLE

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies fluid-applied vapor-permeable membrane air barrier material and accessories used for exterior above grade wall assembly air barriers and their extension and connection to adjacent air barrier components in roof and opening construction to provide a durable, continuous, air- and moisture- impermeable full-building system.

1.2 RELATED WORK

- A. General quality assurance and quality control requirements: Section 01 45 29 TESTING LABORATORY SERVICES.
- B. General sustainable design documentation requirements: Section 01 81 13 SUSTAINABLE DESIGN REQUIREMENTS.
- C. Commissioning of building envelope components: Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- D. Masonry units serving as substrate for membrane air barriers, including preparation of surface: Section 04 20 00 UNIT MASONRY.
- E. Not Used.
- F. Not Used..
- G. Other flashing components to which membrane air barriers will transition: Section 07 60 00 FLASHING AND SHEET METAL.
- H. Joint Sealants: Section 07 92 00, JOINT SEALANTS.
- I. Not Used.
- J. Wall sheathings serving as substrate for membrane air barriers: Section 09 29 00 GYPSUM BOARD.

1.3 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.
 - 1. Air Barrier Association of America (ABAA):Quality Assurance Program
 - 2. American Society of Testing and Materials (ASTM):
 - C920-10.....Standard Specification for Elastomeric Joint Sealants
 - C1193-09.....Standard Guide for Use of Joint Sealants

- D412-06.....Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- D2369-10.....Standard Test Method for Volatile Content of Coatings
- E96/E96M-05.....Standard Test Methods for Water Vapor Transmission of Materials
- E162-09.....Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
- E783-02.....Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors
- E1186-03(2009).....Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
- E2178-03.....Standard Test Method for Air Permeance of Building Materials
- E2357-05.....Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
3. U.S. Environmental Protection Agency (EPA)
- 40 CFR 59, Subpart D....National Volatile Organic Compound Emission Standards for Consumer and Commercial Products
4. SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD):
- 1168-89(2003).....Adhesive and Sealant Applications

1.4 PERFORMANCE REQUIREMENTS

- A. General: Membrane air barrier shall be capable of performing as a continuous vapor- permeable air barrier and as a moisture drainage plane transitioned to adjacent flashings and discharging water to the building exterior. Membrane air barriers shall accommodate substrate movement and seal expansion and control joints, construction material transitions, opening transitions, penetrations, and perimeter conditions without moisture deterioration and air leakage exceeding performance requirements.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.2 L/s x sq. m of surface area at 75 Pa (0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft.)per ASTM E 2357.
- C. Full Building Air Leakage: Refer to Section 01 45 29 TESTING LABORATORY SERVICES

D. Material Compatibility: Provide membrane air barrier materials that are compatible with one another and with adjacent materials under conditions of service and application required, as demonstrated by membrane air barrier manufacturer based on testing and field experience.

1.5 QUALIFICATIONS:

A. Approvals: Approval by Contracting Officer is required of products and services of proposed manufacturers, and installers, and will be based upon submission by Contractor that:

B. Manufacturer Qualifications: Manufacturer regularly and presently manufactures fluid-applied membrane air barrier material meeting section requirements as one of its principal products.

1. Manufacturer's product submitted has been in satisfactory and efficient operation on five similar installations for at least five years.

a. Submit list of installations, include name and location of project and name of owner.

2. Accreditation: Manufacturer is accredited by the Air Barrier Association of America.

C. Installer Qualifications: Installer has technical qualifications, experience, certifications, trained personnel, membrane air barrier manufacturer's approval, and facilities to install specified items.

1. Accreditation: Installer shall be accredited by the Air Barrier Association of America (ABAA) and whose installers are certified in accordance with the site Quality Assurance Program used by ABAA.

2. Installer's applicators shall be trained and certified by manufacturer of air barrier system.

3. Installer's full time on-site field supervisor shall have completed three projects of similar scope within last year, be able to communicate verbally with Contractor, Architect, testing agency, and employees.

a. Certification: Installer's supervisor shall hold Sealant, Waterproofing, and Restoration Institute (SWRI) Wall Coating Validation Program Certificate, or similar qualification acceptable to COR.

- D. Testing Agency Qualifications: Testing laboratory accredited by International Accreditation Service, Inc. or American Association for Laboratory Accreditation.
1. Testing agencies personnel shall be experienced in the installation of specified air barrier system and qualified to perform observation and inspection specified in Field Quality Control Article to determine Installer's compliance with the requirements of this Project.
 2. Accreditation: Contractor's testing agency performing Field Quality Control testing and inspection shall also be certified by ABAA to perform ABAA Quality Assurance Program installer audits.

1.6 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
1. Fluid-applied membrane air barrier.
 2. Primer.
 3. Mastic.
 4. Counterflashing strip.
 5. Modified bituminous strip.
 6. Sprayed polyurethane foam sealant.
 7. Opening transition assembly.
 8. Joint sealant.
 9. Printed installation instructions for conditions specified.
- C. Certificates:
1. Indicating membrane air barrier manufacturer's qualifications as specified.
 2. Indicating approval of installer by membrane air barrier manufacturer.
 3. Indicating qualifications of installer and installer's personnel.
 4. Indicating air barrier manufacturer's determination that proposed materials are chemically and adhesively compatible with adjacent materials.
 5. Indicating products meet project limitations on VOC content.
- D. Inspection Reports: Daily reports of testing agency and reports of testing and inspection agency. Include weather conditions, description of work performed, tests performed, defective work observed, and corrective actions taken to correct defective work.

1.7 COORDINATION:

- A. Coordinate installation of work of this Section with adjacent and related work to ensure provision of continuous, unbroken, durable air barrier system.
- B. Installation Audit: Incorporate audit requirements of ABAA QAP. Coordinate and cooperate with ABAA auditors. Ensure air barrier assembly remains exposed to facilitate inspection, testing, and correction activities.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver materials to job in manufacturer's original unopened containers.
- B. Do not store material in areas where temperature is lower than 10 degrees C (50 degrees F,) or where prolonged temperature is above 32 degrees C (90 degrees F).

1.9 ENVIRONMENTAL REQUIREMENTS:

Ambient Surface and Material Conditions: Not less than 4 degrees C (40 degrees F), during application of waterproofing, visibly dry, and complying with manufacturer's written instructions.

1.10 WARRANTY:

Warrant membrane air barrier installation against air and moisture leaks subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period is two years.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Source Limitations: Obtain membrane air barrier materials and accessories from single manufacturer.
- B. VOC Content: Maximum 250 g/L per 40 CFR 59, Subpart D (EPA Method 24).

2.2 MEMBRANE AIR BARRIER:

- A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane, meeting the following:
 1. Air Permeance, ASTM E 2178: 0.02 L/s x sq. m of surface area at 75-Pa (0.004 cfm/sq. ft of surface area at 1.57-lbf/sq. ft.) pressure difference.
 2. Vapor Permeance, ASTM E 96/E96M: Minimum 580 ng/Pa x s x sq. m (10 perms).
 3. Elongation, Ultimate, ASTM D 412, Die C: 200 percent, minimum.

4. Combustion Characteristics: Flame spread, not greater than 25; smoke developed, not greater than 450, ASTM E 84.
5. Thickness of Membrane Air Barrier: Not less than 1.0 mm (40 mils), applied in single continuous coat.

2.3 ACCESSORY MATERIALS:

- A. Primer: Liquid waterborne primer meeting VOC requirements, recommended for substrate by membrane air barrier manufacturer.
- B. Counterflashing Sheet: Modified bituminous, 1.0-mm- (40-mil- thick self-adhering composite sheet consisting of 0.9 mm (36 mils) of rubberized asphalt laminated to polyethylene film.
- C. Substrate Patching Material: Manufacturer's standard trowel-grade filler material.
- D. Sprayed Polyurethane Foam Sealant: Foamed-in-place, 24- to 32-kg.cu. m (1.5- to 2.0-lb/cu. ft) density, with flame-spread index of 25 or less per ASTM E 162.
- E. Flexible Opening Transition: Cured low-modulus silicone extrusion with reinforcing ribs, sized to fit opening widths, designed for adhesion to or insertion into aluminum framing extrusions, and compatible with air barrier system materials and accessories.
- F. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, approved by membrane air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Surface Condition: Before applying membrane air barrier materials, ensure substrates are fully cured, smooth, clean, dry, and free from high spots, depressions, loose and foreign particles and other deterrents to adhesion.
- B. Verify concrete surfaces have cured for time period recommended by membrane air barrier manufacturer, free from release agents, concrete curing agents, and other contaminants.
- C. Verify masonry joints are flush and filled with mortar.

3.2 INTERFACE WITH OTHER WORK

- A. Commencement of Work: Commence work once membrane air barrier substrates are adequately protected from weather and will remain protected during remainder of construction.

- B. Sequencing of Work: Coordinate sequencing of work with work of other sections that form portions of building envelope air barrier to ensure that flashings and transition materials can be properly installed.
- C. Subsequent Work: Coordinate work with work of other sections installed subsequent to membrane air barrier to ensure complete inspection of installed membrane air barrier and sealing of membrane air barrier penetrations necessitated by subsequent work.

3.3 AIR BARRIER INSTALLATION

- A. General: Prepare substrates and install and apply air barrier components in accordance with air barrier manufacturer's written instructions consistent with manufacturer's qualifying tested assemblies.
 - 1. Compliance: Prepare substrates and install and apply air barrier components in accordance with requirements of ABAA QAP.

3.4 PREPARATION

- A. Prepare and treat substrate in accordance with membrane air barrier manufacturer's written instructions.
- B. Mask adjacent finished surfaces.
- C. Remove contaminants and film-forming coatings from concrete.
- D. Remove projections and excess materials and fill voids with substrate patching material.
- E. Prepare and treat joints and cracks in substrate per ASTM C 1193 and membrane air barrier manufacturer's written instructions.
- F. Apply primer to substrates.

3.5 APPLICATION OF TRANSITION STRIPS

- A. Install transition strips and accessory materials according to membrane air barrier manufacturer's written instructions.
- B. Connect and seal membrane air barrier material to adjacent components of building air barrier system, including, but not limited to, roofing system air barrier, exterior glazing and window systems, curtain wall systems, door framing, and other openings.
- C. Flexible Opening Transition: Prime concealed perimeter frame surfaces of windows, storefronts, curtain walls, louvers, and doors. Apply flexible opening transition so that a minimum of 75 mm (3 inches) over coverage is achieved over each substrate.
 - 1. Fill gaps at perimeter of openings with foam sealant.

- D. Penetrations: Fill gaps at perimeter of penetrations with foam sealant. Seal transition strips around penetrating objects with termination mastic.
- E. Flashings: Seal top of through-wall flashings to membrane air barrier with continuous transitions strip of type recommended by membrane air barrier manufacturer for type of flashing.

3.6 FLUID AIR-BARRIER MEMBRANE INSTALLATION

- A. Apply fluid membrane air barrier material in full contact with substrate to produce a continuous seal with transition strips according to membrane air barrier manufacturers written instructions.
 - 1. Apply fluid membrane in thickness recommended by manufacturer, but not less than thickness specified in this section.
- B. Leave membrane air barrier exposed until tested and inspected by Owner's testing agency and approved by COR.
- C. Correct deficient applications not passing tests and inspections, make necessary repairs, and retest as required to demonstrate compliance with requirements.

3.7 TESTING:

- A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections, including documenting of membrane air barrier prior to concealment.
 - 1. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements, including the following:
 - 2. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 3. Continuous structural support of air-barrier system has been provided.
 - 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 - 5. Site conditions for application temperature and dryness of substrates have been maintained.
 - 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 7. Surfaces have been primed, if applicable.
 - 8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.

9. Termination mastic has been applied on cut edges.
 10. Strips and transition strips have been firmly adhered to substrate.
 11. Compatible materials have been used.
 12. Transitions at changes in direction and structural support at gaps have been provided.
 13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 14. All penetrations have been sealed.
 15. Inspections and testing shall be carried out at the following rate:
 - a. Up to 10,000 square feet (930 square meters) - one inspection
 - b. 10,001 - 35,000 square feet (931 - 3,250 square meters) - two inspections
 - c. 35,001 - 75,000 square feet (3,251 - 6,970 square meters) - three inspections
 - d. 75,001 - 125,000 square feet (6,971 - 11,610 square meters) - four inspections
 - e. 125,001 - 200,000 square feet (11,611 - 18,580 square meters) - five inspections
 - f. Over 200,00 square feet (18,580 square meters) - six inspections.
 16. Forward written inspection reports to the COR within 5 working days of the inspection and test being performed.
 17. If the inspections reveal any defects, promptly remove and replace defective work at no additional cost to the Owner.
- B. Inspections shall include:
1. Compatibility of materials within membrane air barrier system and with adjacent materials.
 2. Suitability of substrate and support for membrane air barrier materials.
 3. Suitability of conditions under which membrane air barrier will be applied.
 4. Adequacy of substrate priming.
 5. Proper application and joint and edge treatment of transition strips, flexible opening transitions, and accessory materials.
 6. Continuity and gap-free installation of membrane air barrier, transition strips, and accessory materials.

C. Testing shall include:

1. Qualitative air-leakage testing per ASTM E 1186.
2. Quantitative air-leakage testing per ASTM E 783.

D. Audit: Provide installer audit by ABAA. Coordinate scheduling of work and associated audit inspections. Cooperate with ABAA's testing agency. Allow access to work areas and staging. Notify ABAA in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted. Arrange and pay for site inspections by ABAA to verify conformance with the manufacturer's instructions, the site Quality Assurance Program used by ABAA, and this section of the project specification.

3.8 CLEANING AND PROTECTION

- A. Clean spills, stains, and overspray resulting application utilizing cleaning agents recommended by manufacturers of affected construction. Remove masking materials.
- B. Protect membrane air barrier from damage from subsequent work. Protect membrane materials from exposure to UV light in excess of that acceptable to membrane air barrier manufacturer; replace overexposed materials and retest.

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**SECTION 07 84 00
FIRESTOPPING**

PART 1 GENERAL

1.1 DESCRIPTION

- A. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction.
- B. Closure of openings in walls against penetration of gases or smoke in smoke partitions.

1.2 RELATED WORK

- A. Expansion and seismic joint firestopping: Section 07 95 13, EXPANSION JOINT COVER ASSEMBLIES.
- B. Spray applied fireproofing: Section 07 81 00, APPLIED FIREPROOFING
- C. Sealants and application: Section 07 92 00, JOINT SEALANTS.
- D. Fire and smoke damper assemblies in ductwork: Section 23 31 00, HVAC DUCTS AND CASINGS Section 23 37 00, AIR OUTLETS AND INLETS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.
- C. List of FM, UL, or WH classification number of systems installed.
- D. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.

1.4 DELIVERY AND STORAGE

- A. Deliver materials in their original unopened containers with manufacturer's name and product identification.
- B. Store in a location providing protection from damage and exposure to the elements.

1.5 WARRANTY

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

1.6 QUALITY ASSURANCE

FM, UL, or WH or other approved laboratory tested products will be acceptable.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - E84-10.....Surface Burning Characteristics of Building Materials
 - E814-11.....Fire Tests of Through-Penetration Fire Stops
- C. Factory Mutual Engineering and Research Corporation (FM):
 - Annual Issue Approval Guide Building Materials
- D. Underwriters Laboratories, Inc. (UL):
 - Annual Issue Building Materials Directory
 - Annual Issue Fire Resistance Directory
 - 1479-10.....Fire Tests of Through-Penetration Firestops
- E. Warnock Hersey (WH):
 - Annual Issue Certification Listings

PART 2 - PRODUCTS**2.1 FIRESTOP SYSTEMS**

- A. Use either factory built (Firestop Devices) or field erected (through-Penetration Firestop Systems) to form a specific building system maintaining required integrity of the fire barrier and stop the passage of gases or smoke.
- B. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 100 mm (4 in) nominal pipe or 0.01 m² (16 sq. in.) in overall cross sectional area.
- C. Products requiring heat activation to seal an opening by its intumescence shall exhibit a demonstrated ability to function as designed to maintain the fire barrier.
- D. Firestop sealants used for firestopping or smoke sealing shall have following properties:
 - 1. Contain no flammable or toxic solvents.
 - 2. Have no dangerous or flammable out gassing during the drying or curing of products.
 - 3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.

4. When used in exposed areas, shall be capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.
- E. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials shall have following properties:
 1. Classified for use with the particular type of penetrating material used.
 2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using firestopping systems that allow unrestricted cable changes without damage to the seal.
 3. Intumescent products which would expand to seal the opening and act as fire, smoke, toxic fumes, and, water sealant.
- F. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84.
- G. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.
- H. Materials to be asbestos free.

2.2 SMOKE STOPPING IN SMOKE PARTITIONS

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

PART 3 - EXECUTION

3.1 EXAMINATION

Submit product data and installation instructions, as required by article, submittals, after an on site examination of areas to receive firestopping.

3.2 PREPARATION

- A. Remove dirt, grease, oil, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke stopping materials.

- B. Remove insulation on insulated pipe for a distance of 150 mm (six inches) on either side of the fire rated assembly prior to applying the firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.

3.3 INSTALLATION

- A. Do not begin work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.
- B. Install firestopping systems with smoke stopping in accordance with FM, UL, WH, or other approved system details and installation instructions.
- C. Install smoke stopping seals in smoke partitions.

3.4 CLEAN-UP AND ACCEPTANCE OF WORK

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

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SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION:

Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK:

- A. Sealing of site work concrete paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- B. Masonry control and expansion joint: Section 04 20 00, UNIT MASONRY.
- C. Firestopping penetrations: Section 07 84 00, FIRESTOPPING.
- D. Not Used.
- E. Not Used.
- F. Not Used.
- G. Mechanical Work: Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

1.3 QUALITY CONTROL:

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
 - 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.

4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
- D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates in accordance with sealant manufacturer's recommendations:
1. Locate test joints where indicated or, if not indicated, as directed by Contracting Officer.
 2. Conduct field tests for each application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.
 - b. Each type of non-elastomeric sealant and joint substrate indicated.
 3. Notify COR seven days in advance of dates and times when test joints will be erected.
- E. VOC: Acrylic latex and Silicon sealants shall have less than 50g/l VOC content.
- F. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:
1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this section.

1.4 SUBMITTALS:

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

1.5 PROJECT CONDITIONS:

- A. Environmental Limitations:
 1. Do not proceed with installation of joint sealants under following conditions:

- a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 °C (40 °F).
 - b. When joint substrates are wet.
- B. Joint-Width Conditions:
- 1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions:
- 1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.6 DELIVERY, HANDLING, AND STORAGE:

- A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.
- B. Carefully handle and store to prevent inclusion of foreign materials.
- C. Do not subject to sustained temperatures exceeding 32° C (90° F) or less than 5° C (40° F).

1.7 DEFINITIONS:

- A. Definitions of terms in accordance with ASTM C717 and as specified.
- B. Back-up Rod: A type of sealant backing.
- C. Bond Breakers: A type of sealant backing.
- D. Filler: A sealant backing used behind a back-up rod.

1.8 WARRANTY:

- A. Warranty exterior sealing against leaks, adhesion, and cohesive failure, and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period shall be extended to two years.
- B. General Warranty: Special warranty specified in this Article shall not deprive Government of other rights Government may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

1.9 APPLICABLE PUBLICATIONS:

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

- B. American Society for Testing and Materials (ASTM):
- C509-06.....Elastomeric Cellular Preformed Gasket and Sealing Material.
 - C612-10.....Mineral Fiber Block and Board Thermal Insulation.
 - C717-10.....Standard Terminology of Building Seals and Sealants.
 - C834-10.....Latex Sealants.
 - C919-08.....Use of Sealants in Acoustical Applications.
 - C920-10.....Elastomeric Joint Sealants.
 - C1021-08.....Laboratories Engaged in Testing of Building Sealants.
 - C1193-09.....Standard Guide for Use of Joint Sealants.
 - C1330-02 (R2007).....Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 - D1056-07.....Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
 - E84-09.....Surface Burning Characteristics of Building Materials.
- C. Sealant, Waterproofing and Restoration Institute (SWRI).
The Professionals' Guide

PART 2 - PRODUCTS

2.1 SEALANTS:

- A. S-1:
 1. ASTM C920, polyurethane or polysulfide.
 2. Type M.
 3. Class 25.
 4. Grade NS.
 5. Shore A hardness of 20-40
- B. S-2:
 1. ASTM C920, polyurethane or polysulfide.
 2. Type M.
 3. Class 25.
 4. Grade P.
 5. Shore A hardness of 25-40.
- C. S-3:
 1. ASTM C920, polyurethane or polysulfide.

2. Type S.
 3. Class 25, joint movement range of plus or minus 50 percent.
 4. Grade NS.
 5. Shore A hardness of 15-25.
 6. Minimum elongation of 700 percent.
- D. S-4:
1. ASTM C920 polyurethane or polysulfide.
 2. Type S.
 3. Class 25.
 4. Grade NS.
 5. Shore A hardness of 25-40.
- E. S-5:
1. ASTM C920, polyurethane or polysulfide.
 2. Type S.
 3. Class 25.
 4. Grade P.
 5. Shore hardness of 15-45.
- F. S-6:
1. ASTM C920, silicone, neutral cure.
 2. Type S.
 3. Class: Joint movement range of plus 100 percent to minus 50 percent.
 4. Grade NS.
 5. Shore A hardness of 15-20.
 6. Minimum elongation of 1200 percent.
- G. S-7:
1. ASTM C920, silicone, neutral cure.
 2. Type S.
 3. Class 25.
 4. Grade NS.
 5. Shore A hardness of 25-30.
 6. Structural glazing application.
- H. S-8:
1. ASTM C920, silicone, acetoxo cure.
 2. Type S.
 3. Class 25.
 4. Grade NS.
 5. Shore A hardness of 25-30.
 6. Structural glazing application.

I. S-9:

1. ASTM C920 silicone.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Non-yellowing, mildew resistant.

J. S-10:

1. ASTM C920, coal tar extended fuel resistance polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 15-20.

K. S-11:

1. ASTM C920 polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 35 to 50.

L. S-12:

1. ASTM C920, polyurethane.
2. Type M/S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade P/NS.
5. Shore A hardness of 25 to 50.

2.2 CAULKING COMPOUND:

- A. C-1: ASTM C834, acrylic latex.
- B. C-2: One component acoustical caulking, non drying, non hardening, synthetic rubber.

2.3 COLOR:

- A. Sealants used with exposed masonry shall match color of mortar joints.
- B. Sealants used with unpainted concrete shall match color of adjacent concrete.
- C. Color of sealants for other locations shall be light gray or aluminum, unless specified otherwise.
- D. Caulking shall be light gray or white, unless specified otherwise.

2.4 JOINT SEALANT BACKING:

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 FILLER:

- A. Mineral fiber board: ASTM C612, Class 1.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

2.6 PRIMER:

- A. As recommended by manufacturer of caulking or sealant material.
- B. Stain free type.

2.7 CLEANERS-NON POUROUS SURFACES:

Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 - EXECUTION**3.1 INSPECTION:**

- A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.
- B. Coordinate for repair and resolution of unsound substrate materials.

- C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 PREPARATIONS:

- A. Prepare joints in accordance with manufacturer's instructions and SWRI.
- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
 - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
 - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
 - 1. Apply primer prior to installation of back-up rod or bond breaker tape.

2. Use brush or other approved means that will reach all parts of joints.

F. Take all necessary steps to prevent three sided adhesion of sealants.

3.3 BACKING INSTALLATION:

- A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

3.4 SEALANT DEPTHS AND GEOMETRY:

- A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.
- B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.5 INSTALLATION:

- A. General:
 - 1. Apply sealants and caulking only when ambient temperature is between 5° C and 38° C (40° and 100° F).
 - 2. Do not use polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
 - 3. Do not use sealant type listed by manufacture as not suitable for use in locations specified.
 - 4. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
 - 5. Avoid dropping or smearing compound on adjacent surfaces.
 - 6. Fill joints solidly with compound and finish compound smooth.
 - 7. Tool joints to concave surface unless shown or specified otherwise.

8. Finish paving or floor joints flush unless joint is otherwise detailed.
 9. Apply compounds with nozzle size to fit joint width.
 10. Test sealants for compatibility with each other and substrate. Use only compatible sealant.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.
- C. Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.
1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
 2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
 3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
 4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
 5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.6 FIELD QUALITY CONTROL:

- A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as recommended by sealant manufacturer:
1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform 10 tests for first 300 m (1000 feet) of joint length for each type of elastomeric sealant and joint substrate.
 - b. Perform one test for each 300 m (1000 feet) of joint length thereafter or one test per each floor per elevation.
- B. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.

- C. Inspect tested joints and report on following:
 - 1. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
 - 2. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - 3. Whether sealants filled joint cavities and are free from voids.
 - 4. Whether sealant dimensions and configurations comply with specified requirements.
- D. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
- E. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.
- F. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.7 CLEANING:

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.
- B. After filling and finishing joints, remove masking tape.
- C. Leave adjacent surfaces in a clean and unstained condition.

3.8 LOCATIONS:

- A. Exterior Building Joints, Horizontal and Vertical:
 - 1. Metal to Metal: Type S-1, S-2
 - 2. Metal to Masonry or Stone: Type S-1
 - 3. Masonry to Masonry or Stone: Type S-1
 - 4. Stone to Stone: Type S-1
 - 5. Cast Stone to Cast Stone: Type S-1

6. Threshold Setting Bed: Type S-1, S-3, S-4
 7. Masonry Expansion and Control Joints: Type S-6
 8. Wood to Masonry: Type S-1
- B. Metal Reglets and Flashings:
1. Flashings to Wall: Type S-6
 2. Metal to Metal: Type S-6
- C. Sanitary Joints:
1. Walls to Plumbing Fixtures: Type S-9
 2. Counter Tops to Walls: Type S-9
 3. Pipe Penetrations: Type S-9
- D. Horizontal Traffic Joints:
1. Concrete Paving, Unit Pavers: Type S-11 or S-12
 2. Garage/Parking Decks: Type S-10
- E. High Temperature Joints over 204 degrees C (400 degrees F):
1. Exhaust Pipes, Flues, Breech Stacks: Type S-7 or S-8
- F. Interior Caulking:
1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1 and C-2.
 2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Types C-1 and C-2.
 3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Types C-1 and C-2.
 4. Perimeter of Lead Faced Control Windows and Plaster or Gypsum Wallboard Walls: Types C-1 and C-2.
 5. Exposed Isolation Joints at Top of Full Height Walls: Types C-1 and C-2.
 6. Exposed Acoustical Joint at Sound Rated Partitions Type C-2.
 7. Concealed Acoustic Sealant Types S-4, C-1 and C-2.

- - - E N D - - -

**SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies steel doors, steel frames and related components.
- B. Terms relating to steel doors and frames as defined in ANSI A123.1 and as specified.

1.2 RELATED WORK

- A. Frames fabricated of structural steel: Section 05 50 00, METAL FABRICATIONS.
- B. Aluminum frames entrance work: Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- C. Doors and frames of a forced entry/ballistic resistant rated: Section 08 34 53, SECURITY DOORS AND FRAMES.
- D. Not Used.
- E. Not Used.
- F. Door Hardware: Section 08 71 00, DOOR HARDWARE.
- G. Glazing and ballistic rated glazing: Section 08 80 00, GLAZING.
- H. Not Used.
- I. Not Used.
- J. Not Used.
- K. Not Used.
- L. Not Used.
- M. Card readers and biometric devices: Section 28 13 00, ACCESS CONTROL.
- N. Not Used.
- O. Not Used.

1.3 TESTING

An independent testing laboratory shall perform testing.

1.4 SUBMITTALS

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

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

1.5 SHIPMENT

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

1.6 STORAGE AND HANDLING

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

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. 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
 - 128-09.....Acoustical Performance for Steel Door and Frame Assemblies
 - A250.8-03 (R2008).....Standard Steel Doors and Frames
- E. American Society for Testing and Materials (ASTM):
 - A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - A568/568-M-11.....Steel, Sheet, Carbon, and High-Strength, Low-alloy, Hot-Rolled and Cold-Rolled
 - A1008-10.....Steel, sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability
 - B209/209M-07.....Aluminum and Aluminum-Alloy Sheet and Plate
 - B221/221M-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
 - D1621-10.....Compressive Properties of Rigid Cellular Plastics

D3656-07.....Insect Screening and Louver Cloth Woven from
Vinyl Coated Glass Yarns

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

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

G. National Fire Protection Association (NFPA):
80-10.....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. Insect Screening: ASTM D3656, 18 by 18 regular mesh.
- E. Aluminum Sheet: ASTM B209/209M.
- F. Aluminum, Extruded: ASTM B221/221M.
- G. Prime Paint: Paint that meets or exceeds the requirements of A250.8.

2.2 FABRICATION GENERAL

- A. GENERAL:
 - 1. Follow 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. Not Used.

- 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. Not Used.
- E. 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.
- F. 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.
- G. Not Used.
- H. Not Used.
- I. Not Used.
- J. Not Used.

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.
 - 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. Not Used.
 5. Not Used.
 6. Frames for doors specified to have automatic door operators; Security doors (Type 36); service window: minimum 1.7 mm (0.067 inch) thick.
 7. Knocked-down frames are not acceptable.
- B. Not Used.
- C. Not Used.
- D. Not Used.
- E. Two piece frames:
- a. One piece unequal leg finished rough buck sub-frames as shown, drilled for anchor bolts.
 - b. Unequal leg finished frames formed to fit subframes and secured to subframe legs with countersunk, flat head screws, spaced 300 mm (12 inches) on center at head and jambs on each side.
 - c. Preassemble at factory for alignment.
- F. 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.
 - 3) Two piece frames: Subframe or rough buck drilled for 6 mm (1/4 inch) bolts.
 - f. Anchors for observation windows and other continuous frames set in stud partitions.
 - 1) In addition to jamb anchors, weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.
 - 2) Anchors spaced 600 mm (24 inches) on centers maximum.
 - g. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

2.4 NOT USED.**2.5 NOT USED.****2.6 SHOP PAINTING**

ANSI A250.8

PART 3 - EXECUTION**3.1 INSTALLATION**

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

- D. Install anchors for labeled fire rated doors to provide rating as required.
- E. Not Used.
- F. Not Used.

3.2 INSTALLATION OF DOORS AND APPLICATION OF HARDWARE

Install doors and hardware as specified in this section and Section 08 71 00, DOOR HARDWARE.

- - - E N D - - -

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Door hardware and related items necessary for complete installation and operation of doors.

1.2 RELATED WORK

- A. Caulking: Section 07 92 00 JOINT SEALANTS.
- B. Application of Hardware: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES
- C. Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.
- D. Painting: Section 09 91 00, PAINTING.
- E. Not Used.
- F. Electrical: Division 26, ELECTRICAL.
- G. Fire Detection: Section 28 31 00, FIRE DETECTION AND ALARM.

1.3 GENERAL

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

5. Floor closers.

1.4 WARRANTY

A. Automatic door operators shall be subject to the terms of FAR Clause 52.246-21, except that the Warranty period shall be 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. Provide installation instructions with the submittal documentation.

1.6 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23. Submit 2 final copies of the final approved schedules to VAMC Locksmith as record copies (VISN Locksmith if the VAMC does not have a locksmith).

B. Hardware Schedule: Prepare and submit hardware schedule in the following form:

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

C. Samples and Manufacturers' Literature:

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

- D. Certificate of Compliance and Test Reports: Submit certificates that hardware conforms to the requirements specified herein. Certificates shall be accompanied by copies of reports as referenced. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an independent laboratory, within four years of submittal of reports for approval.

1.7 DELIVERY AND MARKING

- A. Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to COR for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in COR's office until all other similar items have been installed in project, at which time the COR will deliver items on file to Contractor for installation in predetermined locations on the project.

1.8 PREINSTALLATION MEETING

- A. Convene a preinstallation meeting not less than 30 days before start of installation of door hardware. Require attendance of parties directly affecting work of this section, including Contractor and Installer, Architect, Project Engineer and VA Locksmith, Hardware Consultant, and Hardware Manufacturer's Representative. Review the following:
1. Inspection of door hardware.
 2. Job and surface readiness.
 3. Coordination with other work.
 4. Protection of hardware surfaces.
 5. Substrate surface protection.
 6. Installation.
 7. Adjusting.
 8. Repair.
 9. Field quality control.
 10. Cleaning.

1.9 INSTRUCTIONS

- A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mutes, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by symbols. Symbols for hardware sets consist of letters (e.g., "HW") followed by a

number. Each number designates a set of hardware items applicable to a door type.

- B. Keying: All cylinders shall be keyed into existing Stanley/Best Grand Master Key System. Provide removable core cylinders that are removable only with a special key or tool without disassembly of knob or lockset. Cylinders shall be 7 pin type. Keying information shall be furnished at a later date by the COR.
- C. Keying: A new Great Grandmaster key shall be established for this project. The key system shall be small format (Best size and profile) removable core type as previously described. The key blanks shall be protected by a utility patent with a minimum seven years remaining on the patent from the start of construction, and protected by contract-controlled distribution. The manufacturer shall furnish code pattern listings in both paper and electronic formats so keys may be reproduced by code.; provide electronic format in file type required by project's key control software. The manufacturer shall design the new key system with the capacity to rekey the existing system and also provide for 25 percent expansion capability beyond this requirement. Submit a keying chart for approval showing proposed keying layout and listing expansion capacity.
1. Keying information will be furnished to the Contractor by the COR.
 2. Supply information regarding key control of cylinder locks to manufacturers of equipment having cylinder type locks. Notify COR immediately when and to whom keys or keying information is supplied. Return all such keys to the COR.

1.10 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. In text, hardware items are referred to by series, types, etc., listed in such specifications and standards, except as otherwise specified.
- B. American Society for Testing and Materials (ASTM):
- F883-04.....Padlocks
- E2180-07.....Standard Test Method for Determining the
Activity of Incorporated Antimicrobial Agent(s)
In Polymeric or Hydrophobic Materials

C. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):

- A156.1-06.....Butts and Hinges
- A156.2-03.....Bored and Pre-assembled Locks and Latches
- A156.3-08.....Exit Devices, Coordinators, and Auto Flush Bolts
- A156.4-08.....Door Controls (Closers)
- A156.5-01.....Auxiliary Locks and Associated Products
- A156.6-05.....Architectural Door Trim
- A156.8-05.....Door Controls-Overhead Stops and Holders
- A156.12-05Interconnected 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 NOT USED.**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 NOT USED.

2.6 DOOR STOPS

- A. Conform to ANSI A156.16.
- B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use lead expansion shields for mounting door stops.
- C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.
- D. Provide floor stops (Type L02141 or L02161 in office areas; Type L02121 x 3 screws into floor elsewhere. Wall bumpers, where used, must be installed to impact the trim or the door within the leading half of its width. Floor stops, where used, must be installed within 4-inches of the wall face and impact the door within the leading half of its width.
- E. Where drywall partitions occur, use floor stops, Type L02141 or L02161 in office areas, Type L02121 elsewhere.
- F. Provide stop Type L02011, as applicable for exterior doors. At outswing doors where stop can be installed in concrete, provide stop mated to concrete anchor set in 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).

2.7 NOT USED.

2.8 NOT USED.

2.9 LOCKS AND LATCHES

- A. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over shall have beveled fronts. Lock cylinders shall have not less than seven pins. Cylinders for all locksets shall be removable core type. 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. Provide sectional (lever x rose) lever design matching Falcon S-lever. 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).

2.10 NOT USED.**2.11 NOT USED.****2.12 ELECTRIC STRIKES**

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

2.13 KEYS

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

Locks/Keys	Quantity
Cylinder locks	2 keys each
Cylinder lock change key	100 each different key way

blanks	
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.

2.14 NOT USED.

2.15 ARMOR PLATES, KICK PLATES, MOP PLATES AND DOOR EDGING

- A. Conform to ANSI Standard A156.6.
- B. Provide protective plates and door edging as specified below:
1. Kick plates, mop plates and armor plates of metal, Type J100 series.
 2. Provide kick plates and mop plates where specified. Kick plates shall be 254 mm (10 inches) or 305 mm (12 inches) high. Mop plates shall be 152 mm (6 inches) high. Both kick and mop plates shall be minimum 1.27 mm (0.050 inches) thick. Provide kick and mop plates beveled on all 4 edges (B4E). On push side of doors where jamb stop extends to floor, make kick plates 38 mm (1-1/2 inches) less than width of door, except pairs of metal doors which shall have plates 25 mm (1 inch) less than width of each door. Extend all other kick and mop plates to within 6 mm (1/4 inch) of each edge of doors. Kick and mop plates shall butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.
 3. Kick plates and/or mop plates are not required on following door sides:
 - a. Armor plate side of doors;
 - b. Exterior side of exterior doors;
 - c. Closet side of closet doors;
 - d. Both sides of aluminum entrance doors.
 4. Armor plates for doors are listed under Article "Hardware Sets". Armor plates shall be thickness as noted in the hardware set, 875 mm (35 inches) high and 38 mm (1-1/2 inches) less than width of doors, except on pairs of metal doors. Provide armor plates beveled on all 4 edges (B4E). Plates on pairs of metal doors shall be 25 mm (1

- inch) less than width of each door. Where top of intermediate rail of door is less than 875 mm (35 inches) from door bottom, extend armor plates to within 13 mm (1/2 inch) of top of intermediate rail. On doors equipped with panic devices, extend armor plates to within 13 mm (1/2 inch) of panic bolt push bar.
5. Where louver or grille occurs in lower portion of doors, substitute stretcher plate and kick plate in place of armor plate. Size of stretcher plate and kick plate shall be 254 mm (10 inches) high.
 6. Provide stainless steel edge guards where so specified at wood doors. Provide mortised type instead of surface type except where door construction and/or ratings will not allow. Provide edge guards of bevel and thickness to match wood door. Provide edge guards with factory cut-outs for door hardware that must be installed through or extend through the edge guard. Provide full-height edge guards except where door rating does not allow; in such cases, provide edge guards to height of bottom of typical lockset armor front. Forward edge guards to wood door manufacturer for factory installation on doors.

2.16 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 NOT USED.

2.18 NOT USED

2.19 NOT USED.

2.20 NOT USED.

2.21 NOT USED.

2.22 NOT USED

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 fame face.

2.24 NOT USED.

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 ($0.000774\text{m}^3/\text{s/m}$).

2.26 MISCELLANEOUS HARDWARE

- A. Not Used.
- B. Not Used.
- 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 NOT USED.**2.28 THERMOSTATIC TEMPERATURE CONTROL VALVE CABINETS**

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

2.29 NOT USED.**2.30 FINISHES**

- A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.
- B. 626 or 630: All surfaces on exterior and interior of buildings, except where other finishes are specified.
- C. Miscellaneous Finishes:
 - 1. Hinges --exterior doors: 626 or 630.
 - 2. Hinges --interior doors: 652 or 630.
 - 3. Pivots: Match door trim.
 - 4. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
 - 5. Thresholds: Mill finish aluminum.
 - 6. Cover plates for floor hinges and pivots: 630.
 - 7. Other primed steel hardware: 600.
- D. Hardware Finishes for Existing Buildings: U.S. Standard finishes shall match finishes of hardware in (similar) existing spaces.
- E. Special Finish: Exposed surfaces of hardware for dark bronze anodized aluminum doors shall have oxidized oil rubbed bronze finish (dark bronze) finish on door closers shall closely match doors.
- F. Anti-microbial Coating: All hand-operated hardware (levers, pulls, push bars, push plates, paddles, and panic bars) shall be provided with an anti-microbial/anti-fungal coating that has passed ASTM E2180 tests. Coating to consist of ionic silver (Ag+). Silver ions surround

bacterial cells, inhibiting growth of bacteria, mold, and mildew by blockading food and respiration supplies.

2.31 BASE METALS

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

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

PART 3 - EXECUTION

3.1 HARDWARE HEIGHTS

- A. For new buildings locate hardware on doors at heights specified below, with all hand-operated hardware centered within 864 mm (34 inches) to 1200 mm (48 inches), unless otherwise noted:
- B. Hardware Heights from Finished Floor:
1. Exit devices centerline of strike (where applicable) 1024 mm (40-5/16 inches).
 2. Locksets and latch sets centerline of strike 1024 mm (40-5/16 inches).
 3. Deadlocks centerline of strike 1219 mm (48 inches).
 4. Hospital arm pull 1168 mm (46 inches) to centerline of bottom supporting bracket.
 5. Centerline of door pulls to be 1016 mm (40 inches).
 6. Push plates and push-pull shall be 1270 mm (50 inches) to top of plate.
 7. Push-pull latch to be 1024 mm (40-5/16 inches) to centerline of strike.
 8. Locate other hardware at standard commercial heights. Locate push and pull plates to prevent conflict with other hardware.

3.2 INSTALLATION

- A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted on side of door inside rooms, inside stairs, and away from corridors. At exterior doors, closers shall be mounted on interior side. Where closers are mounted on doors they shall be mounted with sex nuts and bolts; foot shall be fastened to frame with machine screws.

B. Hinge Size Requirements:

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 COR. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.

E. Hinges Required Per Door:

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

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

G. After locks have been installed; show in presence of COR that keys operate their respective locks in accordance with keying requirements. (All keys, Master Key level and above shall be sent Registered Mail to the Medical Center Director along with the bitting list. Also a copy of

the invoice shall be sent to the COR for his records.) Installation of locks which do not meet specified keying requirements shall be considered sufficient justification for rejection and replacement of all locks installed on project.

3.3 FINAL INSPECTION

- A. Installer to provide letter to VA COR/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 COR/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.
- B. Hardware Consultant working on a project will be responsible for providing additional information regarding these hardware sets. The numbers shown in the following sets come from BHMA standards.

ELECTRIC HARDWARE ABBREVIATIONS LEGEND:

ADO = Automatic Door Operator

EMCH = Electro-Mechanical Closer-Holder

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

INTERIOR SINGLE DOORS

HW-E4

Door 001

Each Door to Have:

NON-RATED

Hinges	QUANTITY & TYPE AS REQUIRED
1 Panic Device w/ Night Latch	
1 Flush Bolt Set	
1 Dustproof Strike	
2 Closer with Auxilliary Stop	
2 Kick Plate	
2 Armor Plate	
2 Silencers	
1 Auto Flush Bolt Set	
1 Coordinator	
1 Contact Alarm	

Tie into security alarm system

Note: Astragal part of door, see section 08 11 13.

- - - E N D - - -

SECTION 09 06 00
SCHEDULE FOR FINISHES

SECTION 09 06 00-SCHEDULE FOR FINISHES

VAMC:	STRATTON V.A. MEDICAL CENTER
Location:	ALBANY, NEW YORK
Project no. and Name:	VA VA528A8-10-814 REPAIR HOT WATER LINES PHASE III
Submission:	UNREVIEWED FINAL DESIGN (100%)
Date:	March 20, 2013

**SECTION 09 06 00
SCHEDULE FOR FINISHES**

PART I - GENERAL

1.1 DESCRIPTION

This section contains a coordinated system in which requirements for materials specified in other sections shown are identified by abbreviated material names and finish codes in the room finish schedule or shown for other locations.

1.2 MANUFACTURERS

Manufacturer's trade names and numbers used herein are only to identify colors, finishes, textures and patterns. Products of other manufacturer's equivalent to colors, finishes, textures and patterns of manufacturers listed that meet requirements of technical specifications will be acceptable upon approval in writing by contracting officer for finish requirements.

1.3 SUBMITALS

Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES—provide quadruplicate samples for color approval of materials and finishes specified in this section.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.
- B. MASTER PAINTING INSTITUTE: (MPI)
2001.....Architectural Painting Specification Manual

PART 2- PRODUCTS

2.1 NOT USED.

2.2 DIVISION 31 - EARTHWORK

- A. Not Used.

B. Not Used.

C. SECTION 32 17 23, PAVEMENT MARKINGS.

Color	Manufacturer	MFG. Color Name/No.
Yellow	-	Conform to MPI No. 97
White	-	Conform to MPI No. 97

2.3 DIVISION 03 - CONCRETE

A. SECTION 03 30 00, CAST IN PLACE CONCRETE AND SECTION 03 30 53, MISCELLANEOUS CAST-IN-PLACE CONCRETE

Surface	Finish Description
Exposed	Smooth-form

B. SECTION 03 45 00, PRECAST ARCHITECTURAL CONCRETE

Finish Color	Texture	Finish	Manufacturer	Mfg. Color Name/No.
N/A	--	--	--	--

2.4 NOT USED.

2.5 DIVISION 05 - METALS

A. SECTION 05 50 00, METAL FABRICATION

Item	Finish
Lintels	Primer Paint

2.6 DIVISION 06 WOOD, PLASTICS, AND COMPOSITES

A. SECTION 06 10 00, ROUGH CARPENTRY

Item	Finish	Color
N/A		

B. Not Used

2.7 DIVISION 07 - THERMAL AND MOISTURE PROTECTION

A. SECTION 07 92 00, JOINT SEALANTS

Location	Color	Manufacturer	Manufacturer Color
Precast Concrete Panels	Match adjacent precast color	Tremco	
New to Existing Walls	Match adjacent material to join	Tremco	
Masonry Sealed Joints	Match adjacent material to join	Tremco	

2.8 DIVISION 08 - OPENINGS

A. SECTION 08 11 13, HOLLOW METAL DOORS AND FRAMES

Paint both sides of door and frames same color including ferrous metal louvers, and hardware attached to door	
Component	Color of Paint Type and Gloss
Door	Sherwin Williams
Frame	Sherwin Williams

2.9 DIVISION 09 - FINISHES

A. SECTION 09 91 00, PAINT AND COATINGS

1. MPI Gloss and Sheen Standards		Gloss @60	Sheen @85
Gloss Level 1	a traditional matte finish-flat	max 5 units, and	max 10 units
Gloss Level 2	a high side sheen flat-"a velvet-like" finish	max 10 units, and	10-35 units
Gloss Level 3	a traditional "egg-shell like" finish	10-25 units, and	10-35 units
Gloss Level 4	a "satin-like" finish	20-35 units, and	min. 35 units
Gloss Level 5	a traditional semi-gloss	35-70 units	
Gloss Level 6	a traditional gloss	70-85 units	
Gloss level 7	a high gloss	more than 85 units	

2.10 DIVISION 10 - SPECIALTIES

A. SECTION 10 44 13, FIRE EXTINGUISHER CABINETS

Component	Material	Finish
N/A		

- 2.11 NOT USED.**
- 2.12 NOT USED.**
- 2.13 NOT USED.**
- 2.15 NOT USED.**

2.16 DIVISION 26 - ELECTRICAL

A. SECTION 26 51 00, BUILDING LIGHTING INTERIOR

Fixture Type	Exterior Finish	Color
F1 - fluorescent utility light	Paint	Manufacturer's standard/ white

B. SECTION 26 56 00, SITE LIGHTING

Type and Component	Exterior Finish	Manufacturer	Mfg. Name/No.
N/A			

PART III EXECUTION

3.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS

FINISH SCHEDULE & MISCELLANEOUS ABBREVIATIONS	
Term	Abbreviation
Access Flooring	AF
Accordion Folding Partition	AFP
Acoustical Ceiling	AT
Acoustical Ceiling, Special Faced	AT (SP)

Acoustical Metal Pan Ceiling	AMP
Acoustical Wall Panel	AWP
Acoustical Wall Treatment	AWT
Acoustical Wallcovering	AWF
Anodized Aluminum Colored	AAC
Anodized Aluminum Natural Finish	AA
Baked On Enamel	BE
Brick Face	BR

Brick Flooring	BF	
Brick Paving	BP	
Carpet	CP	
Carpet Athletic Flooring	CAF	
Carpet Module Tile	CPT	
Ceramic Glazed Facing Brick	CGFB	
Ceramic Mosaic Tile	FTCT	
Concrete	C	
Concrete Masonry Unit	CMU	
Divider Strips Marble	DS MB	
Epoxy Coating	EC	
Epoxy Resin Flooring	ERF	
Existing	E	
Exposed Divider Strips	EXP	
Exterior	EXT	
Exterior Finish System	EFS	
Exterior Paint	EXT-P	
Exterior Stain	EXT-ST	
Fabric Wallcovering	WF	
Facing Tile	SCT	
Feature Strips	FS	
Floor Mats & Frames	FM	
Floor Tile, Mosaic	FT	
Fluorocarbon	FC	
Folding Panel Partition	FP	
Foot Grille	FG	
Glass Masonry Unit	GUMU	
Glazed Face CMU	GCMU	
Glazed Structural Facing Tile	SFTU	
Granite	GT	
Gypsum Wallboard	GWB	
High Glazed Coating	SC	
Latex Mastic Flooring	LM	
Linear Metal Ceiling	LMC	
Linear Wood Ceiling	LWC	
Marble	MB	
Material	MAT	

Mortar	M	
Multi-Color Coating	MC	
Natural Finish	NF	
Paint	P	
Paver Tile	PVT	
Perforated Metal Facing (Tile or Panels)	PMF	
Plaster	PL	
Plaster High Strength	HSPL	
Plaster Keene Cement	KC	
Plastic Laminate	HPDL	
Polypropylene Fabric Wallcovering	PFW	
Porcelain Paver Tile	PPT	
Quarry Tile	QT	
Radiant Ceiling Panel System	RCP	
Resilient Stair Tread	RST	
Rubber Base	RB	
Rubber Tile Flooring	RT	
Spandrel Glass	SLG	
Stain	ST	
Stone Flooring	SF	
Structural Clay	SC	
Suspension Decorative Grids	SDG	
Grids		
Terrazzo Portland Cement	PCT	
Terrazzo Tile	TT	
Terrazzo, Thin Set		
Textured Gypsum Ceiling Panel	TGC	
Textured Metal Ceiling Panel	TMC	
Thin set Terrazzo	TST	
Veneer Plaster	VP	
Vinyl Base	VB	
Vinyl Coated Fabric Wallcovering	W	

Vinyl Composition Tile	VCT
Vinyl Sheet Flooring	VSF
Vinyl Sheet Flooring (Welded Seams)	WSF

Wall Border	WB
Wood	WD

3.2 FINISH SCHEDULE SYMBOLS

--- E N D ---

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 11 - EQUIPMENT, Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 - ELECTRONIC SAFETY AND SECURITY sections.
- B. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Asphalt and concrete pavement marking: Section 32 17 23, PAVEMENT MARKINGS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
Before work is started, or sample panels are prepared, submit manufacturer's literature, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.
- C. Sample Panels:
 - 1. After painters' materials have been approved and before work is started submit sample panels showing each type of finish and color specified.
 - 2. 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 NOT USED.**1.6 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. American Conference of Governmental Industrial Hygienists (ACGIH):
 ACGIH TLV-BKLT-2012.....Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
 ACGIH TLV-DOC-2012.....Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)
- C. American National Standards Institute (ANSI):
 A13.1-07.....Scheme for the Identification of Piping Systems
- D. American Society for Testing and Materials (ASTM):
 D260-86.....Boiled Linseed Oil
- E. Commercial Item Description (CID):
 A-A-1555.....Water Paint, Powder (Cementitious, White and Colors) (WPC) (cancelled)
 A-A-3120.....Paint, For Swimming Pools (RF) (cancelled)
- F. Federal Specifications (Fed Spec):
 TT-P-1411A.....Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)
- G. Master Painters Institute (MPI):
 No. 1-12.....Aluminum Paint (AP)
 No. 4-12.....Interior/ Exterior Latex Block Filler
 No. 5-12.....Exterior Alkyd Wood Primer
 No. 7-12.....Exterior Oil Wood Primer
 No. 8-12.....Exterior Alkyd, Flat MPI Gloss Level 1 (EO)
 No. 9-12.....Exterior Alkyd Enamel MPI Gloss Level 6 (EO)
 No. 10-12.....Exterior Latex, Flat (AE)
 No. 11-12.....Exterior Latex, Semi-Gloss (AE)
 No. 18-12.....Organic Zinc Rich Primer
 No. 22-12.....Aluminum Paint, High Heat (up to 590% - 1100F) (HR)
 No. 26-12.....Cementitious Galvanized Metal Primer
 No. 27-12.....Exterior / Interior Alkyd Floor Enamel, Gloss (FE)
 No. 31-12.....Polyurethane, Moisture Cured, Clear Gloss (PV)
 No. 36-12.....Knot Sealer
 No. 43-12.....Interior Satin Latex, MPI Gloss Level 4
 No. 44-12.....Interior Low Sheen Latex, MPI Gloss Level 2
 No. 45-12.....Interior Primer Sealer

- No. 46-12.....Interior Enamel Undercoat
- No. 47-12.....Interior Alkyd, Semi-Gloss, MPI Gloss Level 5 (AK)
- No. 48-12.....Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)
- No. 49-12.....Interior Alkyd, Flat, MPI Gloss Level 1 (AK)
- No. 50-12.....Interior Latex Primer Sealer
- No. 51-12.....Interior Alkyd, Eggshell, MPI Gloss Level 3
- No. 52-12.....Interior Latex, MPI Gloss Level 3 (LE)
- No. 53-12.....Interior Latex, Flat, MPI Gloss Level 1 (LE)
- No. 54-12.....Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)
- No. 59-12.....Interior/Exterior Alkyd Porch & Floor Enamel, Low
Gloss (FE)
- No. 60-12.....Interior/Exterior Latex Porch & Floor Paint, Low
Gloss
- No. 66-12.....Interior Alkyd Fire Retardant, Clear Top-Coat (ULC
Approved) (FC)
- No. 67-12.....Interior Latex Fire Retardant, Top-Coat (ULC
Approved) (FR)
- No. 68-12.....Interior/ Exterior Latex Porch & Floor Paint,
Gloss
- No. 71-12.....Polyurethane, Moisture Cured, Clear, Flat (PV)
- No. 74-12.....Interior Alkyd Varnish, Semi-Gloss
- No. 77-12.....Epoxy Cold Cured, Gloss (EC)
- No. 79-12.....Marine Alkyd Metal Primer
- No. 90-12.....Interior Wood Stain, Semi-Transparent (WS)
- No. 91-12.....Wood Filler Paste
- No. 94-12.....Exterior Alkyd, Semi-Gloss (EO)
- No. 95-12.....Fast Drying Metal Primer
- No. 98-12.....High Build Epoxy Coating
- No. 101-12.....Epoxy Anti-Corrosive Metal Primer
- No. 108-12.....High Build Epoxy Coating, Low Gloss (EC)
- No. 114-12.....Interior Latex, Gloss (LE) and (LG)
- No. 119-12.....Exterior Latex, High Gloss (acrylic) (AE)
- No. 135-12.....Non-Cementitious Galvanized Primer
- No. 138-12.....Interior High Performance Latex, MPI Gloss Level 2
(LF)
- No. 139-12.....Interior High Performance Latex, MPI Gloss Level 3
(LL)
- No. 140-12.....Interior High Performance Latex, MPI Gloss Level 4
- No. 141-12.....Interior High Performance Latex (SG) MPI Gloss
Level 5

H. Steel Structures Painting Council (SSPC):

SSPC SP 1-04 (R2004)....Solvent Cleaning
 SSPC SP 2-04 (R2004)....Hand Tool Cleaning
 SSPC SP 3-04 (R2004)....Power Tool Cleaning

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cementitious Paint (CEP): TT-P-1411A [Paint, Copolymer-Resin, Cementitious (CEP)], Type 1 for exterior use, Type II for interior use.
- B. 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.
- C. 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.
- D. 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.

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. Not Used.
- 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:
 - 1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion in accordance with SSPC-SP 1 (Solvent Cleaning).
 - 2. Spot coat abraded and damaged areas of zinc-coating which expose base metal on hot-dip zinc-coated items with MPI 18 (Organic Zinc Rich Coating). Prime or spot prime with MPI 134 (Waterborne Galvanized Primer) or MPI 135 (Non-Cementitious Galvanized Primer) depending on finish coat compatibility.
- F. Masonry, Concrete, Cement Board, Cement Plaster and Stucco:
 - 1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.
 - 2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
 - 3. Remove loose mortar in masonry work.
 - 4. Replace mortar and fill open joints, holes, cracks and depressions with new mortar specified in Section 04 05 16, MASONRY GROUTING. Do not fill weep holes. Finish to match adjacent surfaces.
 - 5. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three days and brush thoroughly free of crystals.
 - 6. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

3.3 PAINT PREPARATION

- A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.
- B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
- C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.

- D. Mix two component and two part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
- E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.4 APPLICATION

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
- B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
- C. Apply each coat evenly and cover substrate completely.
- D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by COR.
- E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects.
- F. Apply by brush, roller or spray, except as otherwise specified.
- G. Do not spray paint in existing occupied spaces unless approved by COR, except in spaces sealed from existing occupied spaces.
 - 1. Apply painting materials specifically required by manufacturer to be applied by spraying.
 - 2. In areas, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in WORK NOT PAINTED, motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.
- H. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.5 PRIME PAINTING

- A. After surface preparation prime surfaces before application of body and finish coats, except as otherwise specified.
- B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.
- C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.

Not Used. Not Used.F. Metals except boilers, incinerator stacks, and engine exhaust pipes:

1. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer).

3.6 EXTERIOR FINISHES

- A. Apply following finish coats where specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Not Used.
- C. Steel and Ferrous Metal:
 1. Two coats of MPI 72 (Acrylic Polyurethane) on exposed surfaces, except on surfaces over 94 degrees C (200 degrees F) over manufacturers recommended primer.
- D. Machinery without factory finish except for primer: One coat MPI 8 (Exterior Alkyd, Flat (EO)).
- E. Concrete Masonry Units:
 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 NOT USED.

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. Not Used.

- 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 NOT USED.

3.11 BUILDING AND STRUCTURAL WORK FIELD PAINTING

- A. Painting and finishing of interior and exterior work except as specified under paragraph 3.11 B.
 - 1. Painting and finishing of new and existing work including colors and gloss of finish selected is specified in Finish Schedule, 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. Not Used.
 - 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.

3.12 IDENTITY PAINTING SCHEDULE

- A. Identify designated service in accordance with ANSI A13.1, unless specified otherwise, on exposed piping, piping above removable ceilings, piping in accessible pipe spaces, interstitial spaces, and piping behind access panels.
 - 1. Legend may be identified using 2.1 G options or by stencil applications.
 - 2. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12 000 mm (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.
 - 3. Locate Legends clearly visible from operating position.
 - 4. Use arrow to indicate direction of flow.
 - 5. Identify pipe contents with sufficient additional details such as temperature, pressure, and contents to identify possible hazard. Insert working pressure shown on drawings where asterisk appears for High, Medium, and Low Pressure designations as follows:
 - a. High Pressure - 414 kPa (60 psig) and above.
 - b. Medium Pressure - 104 to 413 kPa (15 to 59 psig).
 - c. Low Pressure - 103 kPa (14 psig) and below.
 - d. Add Fuel oil grade numbers.
 - 6. Legend name in full or in abbreviated form as follows:

PIPING	COLOR OF EXPOSED PIPING	COLOR OF BACKGROUND	COLOR OF LETTERS	LEGEND BBREVIATIONS
Hot Water Heating Supply	Yellow	Black	Black	H. W. Htg Sup
Hot Water Heating Return	Yellow	Black	Black	H. W. Htg Ret
Chilled Water Supply	Green	White	White	Ch. Wtr Sup
Chilled Water Return	Green	White	White	Ch. Wtr Ret

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.

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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 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

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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; switchgear and switchboards; 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.
 - 4. Transportation Elements: Mechanical, electrical and structural elements for transport systems, i.e., elevators and dumbwaiters, including hoisting equipment and counterweights.

1.2 RELATED WORK:

- A. Section No. 04 20 00 UNIT MASONRY
- B. Section No. 05 40 00 COLD-FORMED METAL FRAMING
- C. Not Used.
- D. Not Used.
- E. Not Used.
- F. Not Used.
- G. Not Used.
- H. Section No. 23 22 13 STEAM AND CONDENSATE HEATING PIPING
- I. Section No. 23 23 00 REFRIGERANT PIPING
- J. Section No. 23 31 00 HVAC DUCTS AND CASINGS
- K. Section No. 26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
- L. Section No. 26 05 36 CABLE TRAYS FOR ELECTRICAL SYSTEMS

M. Section No. 27 05 33 RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS

1.3 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 COR.
2. Coordinate and install trapezes or other multi-pipe hanger systems prior to pipe installation.

C. Seismic Certification:

In structures assigned to IBC Seismic Design Category C, D, E, or F, permanent equipments and components are to have Special Seismic Certification in accordance with requirements of section 13.2.2 of ASCE 7 except for equipment that are considered rugged as listed in section 2.2 OSHPD code application notice CAN No. 2-1708A.5, and shall comply with section 13.2.6 of ASCE 7.

1.4 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.

1.5 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-08.....Standard Specification for Carbon Structural
Steel

- A53/A53M-10.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- A307-10.....Standard Specification for Carbon Steel Bolts and Studs; 60,000 PSI Tensile Strength.
- A325-10.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- A325M-09.....Standard Specification for High-Strength Bolts for Structural Steel Joints [Metric]
- A490-10.....Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
- A490M-10.....Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric]
- A500/A500M-10.....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-09.....Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- A992/A992M-06.....Standard Specification for Steel for Structural Shapes for Use in Building Framing
- A996/A996M-09.....Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
- E488-96(R2003).....Standard Test Method for Strength of Anchors in Concrete and Masonry Element
- E. American Society of Civil Engineers (ASCE 7) Latest Edition.
- F. International Building Code (IBC) Latest Edition
- G. VA Seismic Design Requirements, H-18-8, February 2011
- H. National Uniform Seismic Installation Guidelines (NUSIG)
- I. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Seismic Restraint Manual - Guidelines for Mechanical Systems, 1998 Edition and Addendum

1.6 REGULATORY REQUIREMENT:

- A. IBC 2003.
- B. Exceptions: The seismic restraint of the following items may be omitted:
1. Equipment weighing less than 400 pounds, which is supported directly on the floor or roof.

2. Equipment weighing less than 20 pounds, which is suspended from the roof or floor or hung from a wall.
3. Gas and medical piping less than 2 ½ inches inside diameter.
4. Piping in equipment rooms less than 1 ¼ inches inside diameter.
5. All other piping less than 2 ½ inches inside diameter, except for automatic fire suppression systems.
6. All piping suspended by individual hangers, 12 inches or less in length from the top of pipe to the bottom of the support for the hanger.
7. All electrical conduits, less than 2 ½ inches inside diameter.
8. All rectangular air handling ducts less than six square feet in cross sectional area.
9. All round air handling ducts less than 28 inches in diameter.
10. All ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of support for the hanger.

PART 2 - PRODUCTS

2.1 STEEL:

- A. Structural Steel: ASTM A36, 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 A325, A490.

2.2 CAST-IN-PLACE CONCRETE:

- A. Concrete: 28 day strength, f'c = 25 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; 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, to resist directional forces (lateral, longitudinal and vertical).
- B. Brace duct branches with a minimum of 1 brace per branch.
- D. 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.
- E. 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.
- F. 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 LIGHTING FIXTURES

- A. Not Used.
- B. Independently support and laterally brace all lighting fixtures. Refer to applicable portion of lighting specification, Section 26 51 00, INTERIOR LIGHTING.

3.6 NOT USED.

3.7 NOT USED.

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

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Section 00 72 00, GENERAL CONDITIONS
- B. Section 01 00 00, GENERAL REQUIREMENTS
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES
- D. Section 31 20 00, EARTH MOVING: Excavation and Backfill
- E. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout
- F. Section 05 50 00, METAL FABRICATIONS
- G. Section 07 84 00, FIRESTOPPING
- H. Section 07 92 00, JOINT SEALANTS
- I. Section 09 91 00, PAINTING
- J. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS
- K. Section 23 07 11, HVAC, PLUMBING, and Boiler Plant Insulation
- L. Section 23 21 13, HYDRONIC PIPING
- M. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training

1.3 QUALITY ASSURANCE

- A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC
- B. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere).

The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.

2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the Resident Engineer.
4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
7. Asbestos products or equipment or materials containing asbestos shall not be used.

C. Equipment Service Organizations:

1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located within 50 miles to the site.

D. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.

- E. Execution (Installation, Construction) Quality:
1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the Resident Engineer for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the Resident Engineer at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.
 2. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.
- 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.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and with requirements in the individual specification sections.
- B. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- C. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- D. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- E. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient.
- F. Layout Drawings:
 1. Submit complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas.

- Refer to Section 00 72 00, GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION.
2. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed layout drawings of all piping systems.
 3. Do not install equipment foundations, equipment or piping until layout drawings have been approved.
 4. In addition, for HVAC systems, provide details of the following:
 - a. Mechanical equipment rooms.
 - b. Hangers, inserts, supports, and bracing.
 - c. Pipe sleeves.
 - d. Piping penetrations of floors, walls, ceilings, or roofs.
- G. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the Resident Engineer.
 2. Submit electric motor data and variable speed drive data with the driven equipment.
 3. Equipment and materials identification.
 4. Fire-stopping materials.
 5. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
 6. Wall, floor, and ceiling plates.
- H. HVAC Maintenance Data and Operating Instructions:
1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
 2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment.
- I. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

1.5 APPLICABLE PUBLICATIONS

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

- B. American National Standard Institute (ANSI):
 B31.1-2007.....Power Piping
- C. Air Movement and Control Association (AMCA):
 410-96.....Recommended Safety Practices for Air Moving
 Devices
- D. American Society of Mechanical Engineers (ASME):
 Boiler and Pressure Vessel Code (BPVC):
 Section IX-2007.....Welding and Brazing Qualifications
 Code for Pressure Piping:
 B31.1-2007.....Power Piping
- E. American Society for Testing and Materials (ASTM):
 A36/A36M-08.....Standard Specification for Carbon Structural
 Steel
 A575-96(2007).....Standard Specification for Steel Bars, Carbon,
 Merchant Quality, M-Grades
 E84-10.....Standard Test Method for Surface Burning
 Characteristics of Building Materials
 E119-09c.....Standard Test Methods for Fire Tests of Building
 Construction and Materials
- F. Manufacturers Standardization Society (MSS) of the Valve and Fittings
 Industry, Inc:
 SP-58-2009.....Pipe Hangers and Supports-Materials, Design and
 Manufacture, Selection, Application, and
 Installation
 SP 69-2003.....Pipe Hangers and Supports-Selection and
 Application
 SP 127-2001.....Bracing for Piping Systems, Seismic - Wind -
 Dynamic, Design, Selection, Application
- G. National Fire Protection Association (NFPA):
 101-09.....Life Safety Code

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protection of Equipment:
1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
 2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Resident Engineer. Such repair or replacement shall be at no additional cost to the Government.

3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
 4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
- B. Cleanliness of Piping and Equipment Systems:
1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
 3. Clean interior of all tanks prior to delivery for beneficial use by the Government.
 4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.7 JOB CONDITIONS - WORK IN EXISTING BUILDING

- A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities, that serve the medical center.
- B. Maintenance of Service: Schedule all work to permit continuous service as required by the medical center.
- C. Phasing of Work: Comply with all requirements shown on drawings or specified.
- D. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. No storm water or ground water leakage permitted. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA.
- E. Acceptance of Work for Government Operation: As new facilities are made available for operation and these facilities are of beneficial use to the Government, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

PART 2 - PRODUCTS**2.1 FACTORY-ASSEMBLED PRODUCTS**

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

2.2 COMPATIBILITY OF RELATED EQUIPMENT

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

2.3 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, and controllers. 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.
 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.

2.4 FIRESTOPPING

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

2.5 GALVANIZED REPAIR COMPOUND

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

2.6 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. Attachment to existing structure: Support from existing floor/roof frame.
- F. Attachment to Wood Construction: Wood screws or lag bolts.
- G. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- H. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.
1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2-inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.
- I. Supports for Piping Systems:
1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
 2. Piping Systems except High and Medium Pressure Steam (MSS SP-58):
 - a. Standard clevis hanger: Type 1; provide locknut.
 - b. Riser clamps: Type 8.
 - c. Wall brackets: Types 31, 32 or 33.
 - d. Roller supports: Type 41, 43, 44 and 46.
 - e. Saddle support: Type 36, 37 or 38.
 - f. Turnbuckle: Types 13 or 15. Preinsulate.
 - g. U-bolt clamp: Type 24.
 - h. 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.

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 and Ductwork: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Comply with MSS SP-127.

2.7 PIPE PENETRATIONS

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- B. To prevent accidental liquid spills from passing to a lower level, provide the following:
 1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.
 2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
 3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of Resident Engineer.

- D. 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.
- E. 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.
- F. 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.
- G. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.8 WALL, FLOOR AND CEILING PLATES

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

2.9 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. 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, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.
- C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Cutting Holes:
1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by Resident Engineer where working area space is limited.
 2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by Resident Engineer. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Resident Engineer for approval.
 3. Do not penetrate membrane waterproofing.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. Electrical and Pneumatic Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- I. Protection and Cleaning:
1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Resident Engineer. Damaged or defective items in the opinion of the Resident Engineer, shall be replaced.

2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- J. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- K. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- L. 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. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall be located in the space equal to the width and depth

of the equipment and extending from to a height of 1.8 m (6 ft.) above the equipment of to ceiling structure, whichever is lower (NFPA 70).

N. Inaccessible Equipment:

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

3.2 TEMPORARY PIPING AND EQUIPMENT

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

3.3 RIGGING

- A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.
- C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.
- E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All

modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.

F. Rigging plan and methods shall be referred to Resident Engineer for evaluation prior to actual work.

G. Restore building to original condition upon completion of rigging work.

3.4 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the Resident Engineer.

B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.

C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work.

D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69. Provide additional supports at valves, 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. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.
3. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 MECHANICAL DEMOLITION

- A. Rigging access, other than indicated on the drawings, shall be provided by the Contractor after approval for structural integrity by the Resident Engineer. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating facility, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Do not permit debris to accumulate in the area to the detriment of plant operation. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VA Medical Center, and Contractor shall follow all directives of the RE or COTR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Completely remove all piping, wiring, conduit, and other devices associated with the equipment not to be re-used in the new work. This includes all pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. Seal all openings, after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to Resident Engineer and

stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

3.6 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. All pipe supports and hardware are to be painted to prevent corrosion. 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. Control valves and thermostatic elements.
 - e. Lubrication devices and grease fittings.
 - f. Copper, brass, aluminum, stainless steel and bronze surfaces.
 - g. Valve stems and rotating shafts.
 - h. Pressure gauges and thermometers.
 - i. 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. 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.

3.7 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 LUBRICATION

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

3.9 COMMISSIONING

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

3.10 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 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.

3.12 INSTRUCTIONS TO VA PERSONNEL

Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS, and Section 23 08 11, DEMONSTRATIONS AND TESTS FOR BOILER PLANT.

- - - E N D - - -

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

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic requirements for non-structural 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 93, TESTING, ADJUSTING, and BALANCING FOR HVAC: Requirements for sound and vibration tests.
- D. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

1.3 QUALITY ASSURANCE

- A. Refer to article, QUALITY ASSURANCE in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Seismic Restraint Requirements:
 - 1. Piping: Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

1.4 SUBMITTALS

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Vibration isolators:
 - b. Hangers
 - c. Snubbers
 - 2. Seismic restraint provisions and bolting.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

- 2009Fundamentals Handbook, Chapter 7, Sound
and Vibration
- C. American Society for Testing and Materials (ASTM):
- A123/A123M-09.....Standard Specification for Zinc (Hot-Dip
Galvanized) Coatings on Iron and Steel
Products
- A307-07b.....Standard Specification for Carbon Steel
Bolts and Studs, 60,000 PSI Tensile
Strength
- D2240-05(2010).....Standard Test Method for Rubber Property
- Durometer Hardness
- D. Manufacturers Standardization (MSS):
- SP-58-2009.....Pipe Hangers and Supports-Materials,
Design and Manufacture
- E. Occupational Safety and Health Administration (OSHA):
- 29 CFR 1910.95.....Occupational Noise Exposure
- F. American Society of Civil Engineers (ASCE):
- ASCE 7-10Minimum Design Loads for Buildings and
Other Structures.
- G. International Code Council (ICC):
- 2009 IBC.....International Building Code.
- H. Department of Veterans Affairs (VA):
- H-18-8 2010.....Seismic Design Requirements.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer but subject to minimum requirements indicated herein and in the schedule on the drawings.
- E. Color code isolators by type and size for easy identification of capacity.

2.3 VIBRATION ISOLATORS

- A. Hangers: Shall be combination neoprene and springs unless otherwise noted and shall allow for expansion of pipe.
1. Combination Neoprene and Spring (Type H): Vibration hanger shall contain a spring and double deflection neoprene element in series. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height

- and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
2. Spring Position Hanger (Type HP): Similar to combination neoprene and spring hanger except hanger shall hold piping at a fixed elevation during installation and include a secondary adjustment feature to transfer load to spring while maintaining same position.
 3. Neoprene (Type HN): Vibration hanger shall contain a double deflection type neoprene isolation element. Hanger rod shall be separated from contact with hanger bracket by a neoprene grommet.
 4. Spring (Type HS): Vibration hanger shall contain a coiled steel spring in series with a neoprene grommet. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
 5. Hanger supports for piping 50 mm (2 inches) and larger shall have a pointer and scale deflection indicator.
 6. Hangers used in seismic applications shall be provided with a neoprene and steel rebound washer installed $\frac{1}{4}$ ' clear of bottom of hanger housing in operation to prevent spring from excessive upward travel
- C. Snubbers: Each spring mounted base shall have a minimum of four all-directional or eight two directional (two per side) seismic snubbers that are double acting. Elastomeric materials shall be shock absorbent neoprene bridge quality bearing pads, maximum 60 durometer, replaceable and have a minimum thickness of 6 mm (1/4 inch). Air gap between hard and resilient material shall be not less than 3 mm (1/8 inch) nor more than 6 mm (1/4 inch). Restraints shall be capable of withstanding design load without permanent deformation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Vibration Isolation:
 1. No metal-to-metal contact will be permitted between fixed and floating parts.
- B. Inspection and Adjustments: Check for vibration and noise transmission through connections and piping. Adjust, repair, or

replace isolators as required to reduce vibration and noise transmissions to specified levels.

3.2 ADJUSTING

- A. Adjust vibration isolators after piping systems are filled and equipment is at operating weight.
- B. Adjust active height of spring isolators.
- C. Adjust snubbers according to manufacturer's recommendations.

3.3 COMMISSIONING

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

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

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

B. Definitions:

1. Basic TAB used in this Section: Chapter 37, "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. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

1.2 RELATED WORK

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General Mechanical Requirements.
- B. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Piping and Equipment Insulation.

1.3 QUALITY ASSURANCE

- A. Refer to Articles, Quality Assurance and Submittals, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Qualifications:
 1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.

2. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the Resident Engineer and submit another TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
3. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the Resident Engineer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.
4. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the Resident Engineer. The responsibilities would specifically include:
 - a. Shall directly supervise all TAB work.

- b. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC or NEBB.
 - c. Would follow all TAB work through its satisfactory completion.
 - d. Shall provide final markings of settings of all HVAC adjustment devices.
 - e. Permanently mark location of duct test ports.
5. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing.
- C. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.
- D. Tab Criteria:
- 1. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by ASHRAE Handbook "HVAC Applications" Chapter 36, and requirements stated herein shall be the basis for planning, procedures, and reports.
 - 2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36, as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 90 percent of final values for pre-filters and after-filters.
 - a. Exhaust fans, cubic meters/min (cubic feet per minute): Minus 0 percent to plus 10 percent.
 - 3. Systems shall be adjusted for energy efficient operation as described in PART 3.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit names and qualifications of TAB agency and TAB specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.

- C. For use by the Resident Engineer staff, submit one complete set of applicable AABC or NEBB publications that will be the basis of TAB work.
- D. Submit Following for Review and Approval:
 - 1. Design Review Report within 90 days for conventional design projects after the system layout on air and water side is completed by the Contractor.
 - 2. Systems inspection report on equipment and installation for conformance with design.
 - 3. Systems Readiness Report.
 - 4. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
 - 5. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.
- E. Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area.

1.5 APPLICABLE PUBLICATIONS

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
 - 2003.....HVAC Applications ASHRAE Handbook, Chapter 37, Testing, Adjusting, and Balancing and Chapter 47, Sound and Vibration Control
- C. Associated Air Balance Council (AABC):
 - 2002.....AABC National Standards for Total System Balance
- D. National Environmental Balancing Bureau (NEBB):
 - 7th Edition 2005Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
 - 1st Edition 1994Procedural Standards for the Measurement and Assessment of Sound and Vibration
 - 2nd Edition 1999Procedural Standards for Building Systems Commissioning

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

3rd Edition 2002HVAC SYSTEMS-Testing, Adjusting and Balancing

PART 2 - PRODUCTS

2.1 INSULATION REPAIR MATERIAL

See Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

Provide for repair of insulation removed or damaged for TAB work.

PART 3 - EXECUTION

3.1 GENERAL

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

3.2 DESIGN REVIEW REPORT

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

3.3 SYSTEMS INSPECTION REPORT

- A. Inspect equipment and installation for conformance with design.
- B. The 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. Check for conformance with submittals.

3.5 SYSTEM READINESS REPORT

- A. Inspect each System to ensure that it is complete including installation and operation of controls.

3.6 TAB REPORTS

- A. The TAB contractor shall provide raw data immediately in writing to the Resident Engineer if there is a problem in achieving intended results before submitting a formal report.
- B. Do not proceed with the remaining systems until intermediate report is approved by the Resident Engineer.

3.7 TAB PROCEDURES

- A. Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.
- B. General: During TAB all related system components shall be in full operation. 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 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.
- F. Water Balance and Equipment Test: Include circulating pumps,
 - 1. Adjust flow rates for equipment.
 - 2. Record final measurements for hydronic equipment on performance data sheets.

3.8 VIBRATION TESTING

- A. Furnish instruments and perform vibration measurements as specified. Field vibration balancing is specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Record initial measurements for each unit of equipment on test forms and submit a report to the Resident Engineer. Where vibration readings exceed the allowable tolerance Contractor shall be directed to correct the problem. The TAB agency shall verify that the corrections are done and submit a final report to the Resident Engineer.

3.10 MARKING OF SETTINGS

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

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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
1. HVAC piping, and equipment.
- B. Definitions
1. ASJ: All service jacket, white finish facing or jacket.
 2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
 3. Cold: Equipment, ductwork or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
 4. Concealed: Piping in chases, and pipe spaces.
 5. Exposed: Piping, and equipment exposed to view in finished areas including mechanical, Boiler Plant and electrical equipment rooms or exposed to outdoor weather. Shafts, chases, 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); 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 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. HWH: Hot water heating supply.
 13. HWHR: Hot water heating return.
 14. CH: Chilled water supply.

15. CHR: Chilled water return.

16. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 23 21 13, HYDRONIC PIPING.
- D. Section 23 21 13, HYDRONIC PIPING: Chilled water piping.

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, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to and 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. (See 4.2.4.2.)

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.

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

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.

4.3.10.2.6.3 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.

(1) 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). Pipe insulation to be high density, minimum 3.0 lb/ft³ [48.055 KG/M³].

2.2 CELLULAR GLASS CLOSED-CELL

- A. Comply with Standard ASTM C177, C518, density 120 kg/m³ (7.5 pcf) nominal, $k = 0.033$ (0.29) at 0 degrees C (75 degrees F).
- B. Pipe insulation for temperatures up to 200 degrees C (400 degrees F).

2.3 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance ≤ 0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets.

Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.

- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 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. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.
- E. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.
- F. 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.

2.5 PIPE COVERING PROTECTION SADDLES

- A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

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

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
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).
- C. Boiler Plant Pipe supports: MSS SP58, Type 39. Apply at all pipe support points, except where MSS SP58, Type 3 pipe clamps provided as part of the support system.

2.6 ADHESIVE, MASTIC, CEMENT

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

2.7 MECHANICAL FASTENERS

- A. Pins, anchors: Welded pins, or metal or nylon anchors with 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.

2.8 REINFORCEMENT AND FINISHES

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

2.9 FIRESTOPPING MATERIAL

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

2.10 FLAME AND SMOKE

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

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Required pressure tests of 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, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. 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. Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16

degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

- D. Install vapor stops at all insulation terminations on either side of valves, equipment and particularly in straight lengths of pipe insulation.
- E. Construct insulation on parts of equipment so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.
- F. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- G. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.
- H. HVAC work not to be insulated:
 - 1. In hot piping: Unions, flexible connectors, safety valves and discharge vent piping, and thermostatic vent valves radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.
- I. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- J. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.
- K. Firestop Pipe insulation:
 - 1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.

2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
 - a. Pipe risers through floors
 - b. Pipe chase walls and floors
 - c. Smoke partitions
 - d. Fire partitions
- L. Provide metal jackets over insulation as follows:
 - a. All piping exposed to outdoor weather.
 - b. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

3.2 INSULATION INSTALLATION

- A. 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. 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)
2. 4-16 degrees C (40-60 degrees F) (CH and CHR)	40 (1.5)	50 (2.0)	50 (2.0)	65 (2.5)

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

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

1.2 RELATED WORK

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

1.3 SUMMARY

- A. This Section includes requirements for commissioning the HVAC systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.
- C. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

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

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.
- B. The following HVAC systems will be commissioned:

1. Exhaust Fans (Fan, motor, Variable Speed Drives, controls and safeties).
2. Direct Digital Control System (BACnet or similar Local Area Network (LAN), Operator Work Station hardware and software, building controller hardware and software, all sequences of operation, system accuracy and response time).
3. HVAC Water Treatment Systems (Closed circuits - including shot feeders and final water analysis, open circuits - including water analysis, chemical/biocide tanks, injection piping, chemical/biocide pumps and motors, controls, water meter, and automatic blowdown.

1.6 SUBMITTALS

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

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRE-FUNCTIONAL CHECKLISTS

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

Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.2 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.3 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

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

3.4 TRAINING OF VA PERSONNEL

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

----- END -----

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. 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. 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.
- C. 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.
- D. Connect the new work to the existing Tracer Summit Control System located throughout the Stratton VA hospital. New work shall seamlessly interface to existing control system and equipment shall operate and function as one complete system including one common 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. Modify the existing ECC workstation if necessary, to accommodate the additional control points.

- a. The intent of this specification is to extend and interoperate with the existing control system as described above, and continue providing a peer-to-peer, networked, distributed control system for the temperature control work that is part of this project. All-components, software and operation shall be interoperable with the existing building automation system. The existing software and databases will be modified to accept the new equipment being installed under this project. Any costs associated with connecting to the existing energy management systems, including licensed software, graphics generation, programming, training, etc., shall be part of the controls contractor's bid. The contractor must demonstrate their ability to perform the integration with the existing system prior to submittal acceptance and any project invoicing. All systems as described in the sequence of operation will be shown via dynamic Web-based graphics with all pertinent system alarms for proper operation and maintenance. The use of separate PC workstations, gateways, metalinks, software drivers, replacement of existing controllers and control devices and additional software graphic packages to accomplish this integration will not be accepted.
- E. The control subcontractor shall supply as required, all necessary hardware equipment and software packages to interface between any existing and new system Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of devices, hardware and software points provided. Network area controllers are same as remote controller units (RCU).
- 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.
- G. The Top End of the NAC shall communicate using American Society of Heating and Refrigerating Engineers/American National Standards

Institute (ASHRAE/ANSI) Standard 135(BACnet) protocol. The NAC shall reside on the BACnet/IP Ethernet (ISO 8802-3) local area network, and provide information via standard BACnet object types and application services. The Bottom End of the NAC, the unit level controllers and all other field devices shall reside on the LonTalk FTT-10a network, and provide data using LonMark standard network variable types and configuration properties.

- H. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system. The ECC requires the incorporation of LonWorks Technologies using Free Topology Transceivers (FTT-10), and specific conformance to the LONMARK Interoperability Association's v3.0 Physical and logical Layer guidelines in all (NAC) Network Area Controllers, Remote Control Unit controllers, unitary terminal unit controllers and other LonMark compliant field devices. The minimum Baud rate shall be 78,000 Baud for FTT-10 and 1,250,000 Baud for FTT-1250.
 - 1. LonTalk communications protocol will be used on the communication network between RCU controllers and LonWorks controllers and devices to assure interoperability between all devices within the network.
 - 2. The ECC shall provide communication to all LonTalk data variables as defined in input/output point schedule and as required to accomplish sequence of operation as specified.
 - 3. Temperature control wiring shall be run in conduit in exposed areas of mechanical spaces or areas prone to damage from moving medical carts, hospital equipment, etc. Temperature control wiring above drop in ceiling tiles can be installed in cable tray's or using other appropriate industry standard supports, but shall not lay on top of the ceiling tiles.

1.2 RELATED WORK

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Section 23 21 13, HYDRONIC PIPING.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- E. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. UCX: 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.

1.5 PERFORMANCE

A. The system shall conform to the following:

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. Multiple Alarm Annunciations: All workstations on the network shall receive alarms within (5) seconds of each other.
7. 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)
Water temperature	±0.5 degrees C [±1 degrees F]
Relative humidity	±2 percent RH

Water flow	±5 percent of full scale
Air flow (measuring stations)	±5 percent of reading
Water pressure	±2 percent of W.G.
Electrical Power	5 percent of full scale *Note 1

Note 1: for both absolute and differential pressure

1.6 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 valves schedule, including the size and pressure drop.
 - 4. 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. 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.

5. Sequence of operations for each HVAC system and the associated control diagrams. Equipment and control labels shall correspond to those shown on the drawings.
 6. Color prints of proposed graphics with a list of points for display.
 7. 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 Government 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 Government reserves the right to modify any or all of the course outline and training material.

F. Submit Performance Report to COTR prior to final inspection.

1.7 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: 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 16 hours of instructions to the VA facilities personnel.
2. 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.
3. Training by independent or franchised dealers who are not direct employees of the controls supplier will not be acceptable.

1.8 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.

1.9 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - Standard 135-08.....BACNET Building Automation and Control Networks
- C. American Society of Mechanical Engineers (ASME):
 - B16.18-05.....Cast Copper Alloy Solder Joint Pressure Fittings.
 - B16.22-05.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- 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. National Fire Protection Association (NFPA):
 - 70-08.....National Electric Code
 - 90A-09.....Standard for Installation of Air-Conditioning and Ventilation Systems
- H. 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
 - 916-07.....Energy Management Equipment
 - 1076-05.....Proprietary Burglar Alarm Units and Systems

PART 2 - PRODUCTS

2.1 CONTROLS SYSTEM ARCHITECTURE

A. General

1. The Controls Systems shall consist of multiple Nodes and associated equipment connected by industry standard digital and communication network arrangements.

B. The Specifications for the individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the Contractor to achieve both compliance with all applicable codes, standards and to meet all requirements of the Contract Documents.

2.2 DIRECT DIGITAL CONTROLLERS

A. (NAC) Network Area Controllers

1. (NAC) Network Area Controllers shall be stand-alone, multi-tasking, multi-user, real-time digital processor complete with all hardware, software, and communications interfaces, power supplies. The Controls System shall be designed and implemented entirely for use and operation on the Internet. NACs shall have access to data within the industry

standard IT network to the Data Server and other NACs as needed to accomplish required global control strategies.

2. NACs shall provide both standalone and networked direct digital control of mechanical and electrical building system controllers as required by the Specifications. The primary NAC shall support a minimum of [5,000] field points together with all associated features, sequences, schedules, applications required for a fully functional distributed processing operation. NACs shall monitor and report communication status to the Controls Systems Application. The Controls Systems shall provide a system advisory upon communication failure and restoration.
3. All NACs on the network shall be equipped with all software functionality necessary to operate the complete user interface, including graphics, via a Browser connected to the Node on the network or directly via a local port on the NAC.
4. All NAC shall be provided with face mounted LED type annunciation to continually display its operational mode, power and communications.
5. The controllers shall reside on the BACnet Ethernet (ISO 8802-3) local area network and provide Read (Initiate) and Write (Execute) services as defined in Clauses 15.5 and 15.8, respectively of ASHRAE Standard 135, to communicate BACnet objects. Objects supported shall include: Analog input, analog output, analog value, binary input, binary output, binary value, and device.
6. Each NAC shall be provided with the necessary un-interruptible power facilities to ensure its continued normal operation during periods of line power outages of, at minimum, 1-minute duration. Normal functionality shall include all normal software processing, communication with powered field devices and network communications with other powered Controls Systems NAC, Data Servers and OWS. Each NAC shall report its communication status to the Application. The Application shall provide a system advisory upon communication failure and restoration. Each NAC shall retain program, control algorithms, and setpoint information in non-volatile memory in the event of a power failure, and shall return to normal operation upon restoration of power.
7. Each NAC shall have sufficient memory to support its operating system, database, and program requirements, including the following:
 1. Device and network management.

2. Data sharing.
 3. Alarm and event management including custom alarm messages for each level alarm for the points noted in the I/O Schedule.
 4. Energy management.
 5. Historical trend data for points specified.
 6. Maintenance report.
 7. Scheduling.
 8. Dial up and network communications.
 9. Manual override monitoring.
8. Each NAC shall support firmware upgrades without the need to replace hardware and shall have a minimum of 15 percent spare capacity of secondary system controllers, point capacity and programming functions.
 9. Each NAC shall continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure shall assume the predetermined failure mode.
 10. Each NAC shall monitor the status of all overrides and inform the operator that automatic control has inhibited, and allow the operator to manually override automatic or centrally executed command.
 11. Provide the capability to generate and modify the Controls Systems Application software-based sequences, database elements, associated operational definition information and user-required revisions to same at any designated Workstation together with the means to download same to the associated System Controllers.
 12. In the event of loss of normal power, there shall be orderly shut down of the controllers to prevent the loss of database or software programming. When power is restored flash memory, battery backup or super capacitor will be automatically loaded into non-volatile flash memory and shall be incorporated for all programming data.
- A. Auxiliary Control Units (ACUs) shall be stand-alone, multi-tasking, multi-user, real time digital processor complete with all hardware, software and communication interfaces, power supplies, and input/output modular devices.

1. ACUs shall either reside on the LonTalk FTT-10a network or provide data using LonMark standard network variable types and configuration properties.
 2. All ACUs shall be provided with LED type annunciation to continually display its operational mode, power and communications.
 3. Each ACU shall have sufficient memory to support its operating system, database including the following:
 - a. Data sharing.
 - b. Device and network management.
 - c. Alarm and event management.
 - d. Scheduling.
 - e. Energy Management.
 4. Each ACU shall support firmware upgrades without the need to replace hardware and shall have a minimum of 15 percent spare capacity of I/O functions. The type of spares shall be in the same proportion as the implemented functions on the controller, but in no case there shall be less than one point of each implemented I/O type.
 5. Each ACU shall continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure shall assume the predetermined failure mode.
 6. In the event of loss of normal power, there shall be orderly shut down of the controllers to prevent the loss of database or software programming. When power is restored flash memory, battery backup or super capacitor will be automatically loaded into non-volatile flash memory and shall be incorporated for all programming data.
- B. Unitary Control Units (UCUs) shall be microprocessor-based. They shall be capable of stand-alone operation, continuing to provide stable control functions if communication is lost with the rest of the system.
1. Unitary Control Units shall either reside on the LonTalk FTT-10a network or provide data using LonMark standard network variable types and configuration properties.
 2. Each UCU shall have sufficient memory to support its own operating system, including data sharing.

3. All UCUs shall be provided with LED type annunciation to continually display its operational mode, power and communications.
 4. In the event of loss of normal power, there shall be orderly shut down of the controllers to prevent the loss of database or software programming. When power is restored flash memory, battery backup or super capacitor will be automatically loaded into non-volatile flash memory and shall be incorporated for all programming data.
- C. Provide I/O module that connects sensors and actuators onto the field bus network for use by the direct digital controllers. I/O devices shall support the communication technology specified for each controller.
1. Analog input shall allow the monitoring of low voltage (0-10 VDC), current (4-20 ma), or resistance signals (thermistor, RTD). Analog input shall be compatible with, and field configurable to commonly available sensing devices. Analog output shall provide a modulating signal for these control devices.
 2. Binary inputs shall allow the monitoring of on/off signals from remote devices. Binary inputs shall provide a wetting current of at least 12 milliamps to be compatible with commonly available control devices. Binary outputs shall provide on/off operation, or a pulsed low voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.
 3. Binary outputs on remote and auxiliary controllers shall have 3-position (on/off/auto) override switches and status lights. Analog outputs on remote and auxiliary controllers shall have status lights and a 2-position (auto/manual) switch and manually adjustable potentiometer for manual override.
 4. Each output point shall be provided with a light emitting diode (LED) to indicate status of outputs.

D. Communication Ports:

1. NACs controllers in the DDC systems shall be connected in a system local area network using protocol defined by ASHRAE Standard 135, BACnet protocol.
2. The control supplier shall provide connectors, repeaters, hubs, and routers necessary for inter-network communication.
3. Minimum baud rate between the peer-to-peer controllers in the system LAN shall be maintained at the rate of 10 Mbps. Minimum baud for the low level controllers between UCUs and ACUs, ACUs and NAC's shall be maintained at the rate of 76 Kbps.
4. Provide RS-232 port with DB-9 or RJ-11 connector for communication with each controller that will allow direct connection of standard printers, operator terminals, modems, and portable laptop operator's terminal. Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or terminals.
5. Database, such as points; status information, reports, system software, custom programs of any one controller shall be readable by any other controller on the network.

- E. Electric Outlet: Provide single phase, 120 VAC electrical receptacles inside or within 2 meters (6 feet) of the NAC and ACU enclosures for use with test equipment.

2.3 DIRECT DIGITAL CONTROLLER SOFTWARE

- A. The software programs specified in this section shall be commercially available, concurrent, multi-tasking operating system and support the use of software application that operates under DOS or Microsoft Windows.
- B. All points shall be identified by up to 30-character point name and 16-character point descriptor. The same names shall be used at the operator workstation.
- C. All control functions shall execute within the stand-alone control units via DDC algorithms. The VA shall be able to customize control strategies and sequences of operations defining the appropriate control loop algorithms and choosing the optimum loop parameters.
- D. 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, or by loss of bus communication. Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors. Loss of an input sensor shall result in output of a sensor-failed message at the ECC workstation. Each ACU and RCU shall have capability for local readouts of all functions. The UCUs shall be read remotely.

- E. All DDC control loops shall be able to utilize any of the following control modes:
 - 1. Two position (on-off, slow-fast) control.
 - 2. Proportional control.
 - 3. Proportional plus integral (PI) control.
 - 4. Proportional plus integral plus derivative (PID) control.
All PID programs shall automatically invoke integral wind up prevention routines whenever the controlled unit is off, under manual control of an automation system or time initiated program.
- F. System Security: Operator access shall be secured using individual password and operator's name. Passwords shall restrict the operator to the level of object, applications, and system functions assigned to him. A minimum of six (6) levels of security for operator access shall be provided.
- G. Application Software: The CUs shall provide the following programs as a minimum for the purpose of optimizing energy consumption while maintaining comfortable environment for occupants. All application software shall reside and run in the system digital controllers.
- H. Editing of the application shall occur at the operator workstation or via a portable workstation, when it is necessary, to access directly the programmable unit.
 - 1. Event Scheduling: Provide a comprehensive menu driven program to automatically start and stop designated points or a group of points according to a stored time. This program shall provide the capability to individually command a point or group of points. When points are assigned to one common load group it shall be possible to assign variable time advances/delays between each successive start or stop within that group. Scheduling shall be calendar based and advance schedules may be defined up to one year in advance. Advance

schedule shall override the day-to-day schedule. The operator shall be able to define the following information:

- a. Time, day.
- b. Commands such as on, off, auto.
- c. Time delays between successive commands.
- d. Manual overriding of each schedule.
- e. Allow operator intervention.

2. Alarm Reporting: The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and events. An alarm shall be able to start programs, login the event, print and display the messages. The system shall allow the operator to prioritize the alarms to minimize nuisance reporting and to speed operator's response to critical alarms. A minimum of six (6) priority levels of alarms shall be provided for each point.

3. Remote Communications: The system shall have the ability to dial out in the event of an alarm to workstations and alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications. Remote access shall allow the operator to function the same as local access.

A. System Software

1. System Graphics. The existing Tracer Summit workstations shall be updated to reflect the changes made in this project. They shall be updated on the existing workstations and match the existing graphics currently in use throughout the facility.

2.3.1 REMOTE ACCESS

A. Owner shall provide remote access capability through any or all of the following methods.

- a. VPN (Virtual Private Networking)
- b. Public Static IP address (Not located behind a firewall.)

2.4 SENSORS (AIR AND WATER)

A. Temperature and Humidity Sensors:

1. Electronic Sensors: Provide all remote sensors as required for the systems. All sensors shall be vibration and corrosion resistant for wall, immersion, and/or duct mounting.

a. Temperature Sensors: Thermistor type for terminal units and Resistance Temperature Device (RTD) with an integral transmitter type for all other sensors.

1) Immersion sensors shall be provided with a separable well made of stainless steel, bronze or metal material. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.

2) Space sensors shall be equipped with set-point adjustment, override switch, display, and/or communication port as shown on the drawings. Match room thermostats, locking cover.

3) Wire: Twisted, shielded-pair cable.

4) Output Signal: 4-20 ma.

b. Humidity Sensors: Bulk polymer sensing element type.

1) 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.

2) Outdoor humidity sensors shall be furnished with element guard and mounting plate and have a sensing range of 0 to 100 percent RH.

3) 4-20 ma continuous output signal.

c. Water flow sensors:

1. Type: Insertion vortex type with retractable probe assembly and in full port gate valve.

a. Pipe size: 3 to 24 IN.

b. Retractor: ASME threaded, non-rising stem type with hand wheel.

c. Mounting connection: 2 IN 150 PSI flange.

d. Sensor assembly: Design for expected water flow and pipe size.

e. Seal: Teflon (PTFE).

B. Controller:

1. Integral to unit.
 - a. Locally display flow rate and total.
 - b. Output flow signal to BMCS: Digital pulse type.
2. Performance:
 - a. Accuracy: 1.0% of reading
 - b. Repeatability: 0.15% of reading
 - c. Turndown: 20:1
 - d. Response time: Adjustable from 1 to 100 seconds.
 - e. Power: 24 volt DC

C. Install flow meters according to manufacturer's recommendations. Where recommended by manufacturer because of mounting conditions.

D. Flow switches:

1. Shall be either paddle or differential pressure type or electronic.
 - a. Paddle-type switches (liquid service only) shall be UL Listed, SPDT snap-acting, adjustable sensitivity with NEMA 4 enclosure.
 - b. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap acting, NEMA 4 enclosure, with scale range and differential suitable for specified application.

E. Current Switches: Current operated switches shall be self powered, solid state with adjustable trip current as well as status, power, and relay command status LED indication. The switches shall be selected to match the current of the application and output requirements of the DDC systems.

2.5 CONTROL CABLES

As specified in Division 26.

2.6 THERMOSTATS AND HUMIDISTATS

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 range and temperature display and external adjustment:

1. Electronic Thermostats: Solid-state, microprocessor based, programmable to daily, weekend, and holiday schedules.

- a. Space Thermostat: space thermostat shall be a platinum sensor and shall not have a visible means of set point adjustment. Adjustment shall be via the digital controller to which it is connected.
- b. Battery replacement without program loss.
- c. Room Humidistats: Provide fully proportioning humidistat with adjustable throttling range for accuracy of settings and conservation. The humidistat shall have set point scales shown in percent of relative humidity located on the instrument. Systems showing moist/dry or high/low are not acceptable.

2.7 FINAL CONTROL ELEMENTS AND OPERATORS

A. Fail Safe Operation: Control valves and dampers shall provide "fail safe" operation in either the normally open or normally closed position as required for freeze, moisture, and smoke or fire protection.

B. Spring Ranges: Range as required for system sequencing and to provide tight shut-off.

E. Control Valves:

1. Valves shall be rated for a minimum of 150 percent of system operating pressure at the valve location but not less than 125 psig.

3. Valves 2 1/2 inches and larger shall be bronze or iron body with flanged connections.

4. Brass or bronze seats except for valves controlling media above 210 degrees F, which shall have stainless steel seats.

5. Flow characteristics:

- a. Two-way valves position versus flow relation shall be equal percentage for water flow control.

6. Maximum pressure drop:

a. Modulating water flow control, greater of 3 meters (10 feet) of water or the pressure drop through the apparatus.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Examine project plans for control devices and equipment locations; and report any discrepancies, conflicts, or omissions to COTR for resolution before proceeding for installation.
2. Work Coordination: See GENERAL REQUIREMENTS.
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. 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 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. Use of sensors shall be limited to its duty, e.g., duct sensor shall not be used in lieu of room sensor.
- c. Install room sensors permanently supported on wall frame. They shall be mounted at 5.0 feet above the finished floor.
- d. Mount sensors rigidly and adequately for the environment within which the sensor operates.
- e. 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.
- f. 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.
- g. 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. Actuators:

- a. Mount and link valve actuators according to manufacturer's written instructions.
- b. Check operation of valve/actuator combination to confirm that actuator modulates valve smoothly in both open and closed position.

3. 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.

2. Echelon:

- a. The ECC shall employ LonTalk communications FTT-10.
- b. Echelon LAN: The ECC shall employ a LON LAN that will connect through an Echelon Communication card directly to all controllers on the FTT-10 LAN.

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 air handling unit, fan, terminal unit, etc. These graphics shall show all points dynamically as specified in the point list.

G. DEMONSTRATION

- 1. System operation and calibration to be demonstrated by the Installer in the presence of the Architect or Government's representative on random samples of equipment as dictated by the Government's representative. Should random sampling indicate improper commissioning, the government reserves the right to subsequently

witness complete calibration of the system at no addition cost to the government.

2. Demonstrate to authorities that all required safeties and life safety functions are fully functional and complete.
3. Make accessible as required personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.
4. The following witnessed demonstrations of field control equipment shall be included:
 - a. Observe HVAC systems in shut down condition. Check dampers and valves for normal position.
 - b. Test application software for its ability to communicate with digital controllers, operator workstation, and uploading and downloading of control programs.
 - c. Demonstrate the software ability to edit the control program off-line.
 - d. Demonstrate reporting of alarm conditions for each alarm and ensure that these alarms are received at the assigned location, including operator workstations.
 - e. Demonstrate ability of software program to function for the intended applications-trend reports, change in status etc.
 - f. Demonstrate via graphed trends to show the sequence of operation is executed in correct manner, and that the HVAC systems operate properly through the complete sequence of operation, e.g., seasonal change, occupied/unoccupied mode, and warm-up condition.
 - g. Demonstrate hardware interlocks and safeties functions, and that the control systems perform the correct sequence of operation after power loss and resumption of power loss.
 - h. Prepare and deliver to the VA graphed trends of all control loops to demonstrate that each control loop is stable and the set points are maintained.
 - i. Demonstrate that each control loop responds to set point adjustment and stabilizes within one (1) minute. Control loop

trend data shall be instantaneous and the time between data points shall not be greater than one (1) minute.

---END---

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Water piping to connect HVAC equipment, including the following:
 - 1. Chilled water, heating hot water and drain piping.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- C. Section 31 20 00, EARTH MOVING: Excavation and backfill.
- D. Section 03 30 00, CAST-IN-PLACE CONCRETE.
- E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for piping.
- F. 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.
- G. Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION: Piping insulation.

1.3 QUALITY ASSURANCE

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION, which includes welding qualifications.
- B. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one year old.
- C. For mechanical pressed sealed fittings, only tools of fitting manufacturer shall be used.
- D. Mechanical pressed fittings shall be installed by factory trained workers.
- E. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be the same manufacturer as the grooved components.
 - 1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.4 SUBMITTALS

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

1. Pipe and equipment supports. Submit calculations for variable spring and constant support hangers.
 2. Pipe and tubing, with specification, class or type, and schedule.
 3. Pipe fittings, including miscellaneous adapters and special fittings.
 4. Flanges, gaskets and bolting.
 5. Grooved joint couplings and fittings.
 6. Valves of all types.
 7. Pipe alignment guides.
 8. Expansion joints.
 9. Expansion compensators.
 10. All specified hydronic system components.
 11. Water flow measuring devices.
 12. Gages.
 13. Thermometers and test wells.
 14. Seismic bracing details for piping.
- C. Submit the welder's qualifications in the form of a current (less than one year old) and formal certificate.
- D. Coordination Drawings: Refer to Article, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- E. As-Built Piping Diagrams: Provide drawing as follows for chilled water, and heating hot water system and other piping systems and equipment.
1. One wall-mounted stick file with complete set of prints. Mount stick file in the chiller plant or control room along with control diagram stick file.
 2. One complete set of reproducible drawings.
 3. One complete set of drawings in electronic Autocad and pdf format.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. American National Standards Institute, Inc.
- B. American Society of Mechanical Engineers/American National Standards Institute, Inc. (ASME/ANSI):
- B1.20.1-83(R2006).....Pipe Threads, General Purpose (Inch)
- B16.4-06.....Gray Iron Threaded Fittings B16.18-01 Cast
Copper Alloy Solder joint Pressure fittings
- B16.23-02.....Cast Copper Alloy Solder joint Drainage
fittings

- B40.100-05.....Pressure Gauges and Gauge Attachments
- C. American National Standards Institute, Inc./Fluid Controls Institute
(ANSI/FCI):
- 70-2-2006.....Control Valve Seat Leakage
- D. American Society of Mechanical Engineers (ASME):
- B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings
- B16.3-2006.....Malleable Iron Threaded Fittings: Class 150 and
300
- B16.4-2006.....Gray Iron Threaded Fittings: (Class 125 and
250)
- B16.5-2003.....Pipe Flanges and Flanged Fittings: NPS ½
through NPS 24 Metric/Inch Standard
- B16.9-07.....Factory Made Wrought Butt Welding Fittings
- B16.11-05.....Forged Fittings, Socket Welding and Threaded
- B16.18-01.....Cast Copper Alloy Solder Joint Pressure
Fittings
- B16.22-01.....Wrought Copper and Bronze Solder Joint Pressure
Fittings.
- B16.24-06.....Cast Copper Alloy Pipe Flanges and Flanged
Fittings
- B16.39-06.....Malleable Iron Threaded Pipe Unions
- B16.42-06.....Ductile Iron Pipe Flanges and Flanged Fittings
- B31.1-08.....Power Piping
- E. American Society for Testing and Materials (ASTM):
- A47/A47M-99 (2004).....Ferritic Malleable Iron Castings
- A53/A53M-07.....Standard Specification for Pipe, Steel, Black
and Hot-Dipped, Zinc-Coated, Welded and
Seamless
- A106/A106M-08.....Standard Specification for Seamless Carbon
Steel Pipe for High-Temperature Service
- A126-04.....Standard Specification for Gray Iron Castings
for Valves, Flanges, and Pipe Fittings
- A183-03 Standard Specification for Carbon Steel Track
Bolts and Nuts
- A216/A216M-08 Standard Specification for Steel Castings,
Carbon, Suitable for Fusion Welding, for High
Temperature Service

- A234/A234M-07 Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
- A307-07 Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
- A536-84 (2004) Standard Specification for Ductile Iron Castings
- A615/A615M-08 Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
- A653/A 653M-08 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) By the Hot-Dip Process
- B32-08 Standard Specification for Solder Metal
- B62-02 Standard Specification for Composition Bronze or Ounce Metal Castings
- B88-03 Standard Specification for Seamless Copper Water Tube
- B209-07 Aluminum and Aluminum Alloy Sheet and Plate
- C177-04 Standard Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus
- C478-09 Precast Reinforced Concrete Manhole Sections
- C533-07 Calcium Silicate Block and Pipe Thermal Insulation
- C552-07 Cellular Glass Thermal Insulation
- D3350-08 Polyethylene Plastics Pipe and Fittings Materials
- C591-08 Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
- F. American Welding Society (AWS):
- B2.1-02.....Standard Welding Procedure Specification
- G. Copper Development Association, Inc. (CDA):
- CDA A4015-06.....Copper Tube Handbook
- H. Expansion Joint Manufacturer's Association, Inc. (EJMA):
- EMJA-2003.....Expansion Joint Manufacturer's Association Standards, Ninth 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-80-08.....	Bronze Gate, Globe, Angle and Check Valves
SP-85-02.....	Cast Iron Globe and Angle Valves, Flanged and Threaded Ends
SP-110-96.....	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
SP-125-00.....	Gray Iron and Ductile Iron In-line, Spring Loaded, Center-Guided Check Valves

1.6 SPARE PARTS

- A. For mechanical pressed sealed fittings provide tools required for each pipe size used at the facility.

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

- A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

2.2 PIPE AND TUBING

- A. Chilled Water, Heating Hot Water, and Vent Piping:
1. Steel: ASTM A53 Grade B, seamless or ERW, Standard weight.
 2. Copper water tube option: ASTM B88, Type K or L, hard drawn.
- B. Pipe supports, including insulation shields, for above ground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

2.3 FITTINGS FOR STEEL PIPE

- A. 50 mm (2 inches) and Smaller: Screwed or welded joints.
1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
 2. Forged steel, socket welding or threaded: ASME B16.11.
 3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
 4. Unions: ASME B16.39.
 5. Water hose connection adapter: Brass, pipe thread to 20 mm (3/4 inch) garden hose thread, with hose cap nut.
- B. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints. Contractor's option: Grooved mechanical couplings and fittings are optional.

1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
2. Welding flanges and bolting: ASME B16.5:
 - a. Water service: Weld neck or slip-on, plain face, with 6 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).
 - 1) Contractor's option: Convuluted, cold formed 150 pound steel flanges, with teflon gaskets, may be used for water service.
 - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gage connections.
- D. Grooved Mechanical Pipe Couplings and Fittings (Contractor's Option): Grooved Mechanical Pipe Couplings and Fittings may be used, with cut or roll grooved pipe, in water service up to 110 degrees C (230 degrees F) in lieu of welded, screwed or flanged connections. All joints must be rigid type.
 1. Grooved mechanical couplings: Malleable iron, ASTM A47 or ductile iron, ASTM A536, fabricated in two or more parts, securely held together by two or more track-head, square, or oval-neck bolts, ASTM A449 and A183.
 2. Gaskets: Rubber product recommended by the coupling manufacturer for the intended service.
 3. Grooved end fittings: Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A53 or A106, designed to accept grooved mechanical couplings. Tap-in type branch connections are acceptable.

2.4 FITTINGS FOR COPPER TUBING

- A. Joints:
 1. Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
 2. Contractor's Option: Mechanical press sealed fittings, double pressed type, NSF 50/61 approved, with EPDM (ethylene propylene diene monomer) non-toxic synthetic rubber sealing elements for up 65

mm (2-1/2 inch) and below are optional for above ground water piping only.

3. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.
- B. Bronze Flanges and Flanged Fittings: ASME B16.24.
- C. Fittings: ANSI/ASME B16.18 cast copper or ANSI/ASME B16.22 solder wrought copper.

2.5 DIELECTRIC FITTINGS

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- C. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- D. Temperature Rating, 99 degrees C (210 degrees F).
- E. Contractor's option: On pipe sizes 2" and smaller, screwed end brass ball valves or dielectric nipples may be used in lieu of dielectric unions.

2.6 SCREWED JOINTS

- A. Pipe Thread: ANSI B1.20.
- B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.7 VALVES

- A. Asbestos packing is not acceptable.
- B. All valves of the same type shall be products of a single manufacturer.
- C. Shut-Off Valves
 1. Ball Valves (Pipe sizes 2" and smaller): MSS-SP 110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at 600 psig working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.

2.8 EXPANSION JOINTS

- A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and

contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.

- B. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.
- C. Bellows - Externally Pressurized Type:
 1. Multiple corrugations of Type 304 stainless steel.
 2. Internal and external guide integral with joint.
 3. Design for external pressurization of bellows to eliminate squirm.
 4. Welded ends.
 5. Conform to the standards of EJMA and ASME B31.1.
 6. Threaded connection at bottom, 25 mm (one inch) minimum, for drain or drip point.
 7. Integral external cover and internal sleeve.
- D. Expansion Joint Identification: Provide stamped brass or stainless steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.
- E. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.
- F. Supports: Provide saddle supports and frame or hangers for heat exchanger. Mounting height shall be adjusted to facilitate gravity return of steam condensate. Construct supports from steel, weld joints.
- G. Automatic Air Vent Valves (where shown): Cast iron or semi-steel body, 1034 kPa (150 psig) working pressure, stainless steel float, valve, valve seat and mechanism, minimum 15 mm (1/2 inch) water connection and 6 mm (1/4 inch) air outlet. Air outlet shall be piped to the nearest floor drain.

2.9 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.

2.10 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.

2.11 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. 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. 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.
- D. 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.

- E. 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.
- F. 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.
- G. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.
- H. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
 - 1. Flow elements (orifice unions), pressure taps with valve, and wells for sensors.
- I. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.
- J. Where copper piping is connected to steel piping, provide dielectric connections.

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.

3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

- A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.
- B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.
- C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.
- D. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding.

3.4 SEISMIC BRACING ABOVEGROUND PIPING

Provide in accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 LEAK TESTING ABOVEGROUND PIPING

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the 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.

3.6 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
1. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/S (6 feet per second), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the 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.

3.7 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.

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SECTION 23 25 00
HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies cleaning of circulating HVAC water systems, including the following.

1. Cleaning compounds.

1.2 RELATED WORK

- A. Test requirements and instructions on use of equipment/system: Section 01 00 00, GENERAL REQUIREMENTS.
- B. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- C. Piping and valves: Section 23 21 13, HYDRONIC PIPING.

1.3 QUALITY ASSURANCE

- A. Refer to paragraph, QUALITY ASSURANCE in Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Technical Services: Provide the services of an experienced water treatment technical representative to direct flushing, cleaning, pre-treatment, training, debugging, and acceptance testing operations; direct and perform chemical limit control during construction period Minimum service during construction/start-up shall be 6 hours.
- E. Chemicals: Chemicals shall be non-toxic approved by local authorities and meeting applicable EPA requirements.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data including:
1. Cleaning compounds and recommended procedures for their use.
- C. Water analysis verification.
- D. Materials Safety Data Sheet for all proposed chemical compounds, based on U.S. Department of Labor Form No. L5B-005-4.
- E. Maintenance and operating instructions in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1.5 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. National Fire Protection Association (NFPA):
70-2008.....National Electric Code (NEC)

PART 2 - PRODUCTS

2.1 CLEANING COMPOUNDS

- A. Alkaline phosphate or non-phosphate detergent/surfactant/specific to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and like deleterious substances, with or without inhibitor, suitable for system wetted metals without deleterious effects.
- B. All chemicals to be acceptable for discharge to sanitary sewer.
- C. Refer to Section 23 21 13, HYDRONIC PIPING, PART 3, for flushing and cleaning procedures.

2.5 EQUIPMENT AND MATERIALS IDENTIFICATION

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Delivery and Storage: Deliver all chemicals in manufacturer's sealed shipping containers. Store in designated space and protect from deleterious exposure and hazardous spills.
 - 1. Provide installation supervision, start-up and operating instruction by manufacturer's technical representative.
- E. Do not valve in or operate system pumps until after system has been cleaned.
- F. After chemical cleaning is satisfactorily completed, clean all strainers.
- G. Perform tests and report results in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
- I. Instruct VA personnel in system maintenance and operation in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

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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, switchgear, panelboards, motor control centers, generators, automatic transfer switches, 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.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

Applicable publications listed in all Sections of Division are the latest issue, unless otherwise noted.

1.6 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.
- 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.

1.7 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.

1.8 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 switchgear, switchboards, panelboards, transformers, motor control centers, motor controllers, uninterruptible power systems, 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.

1.9 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. Before initiating any work, a job specific work plan must be developed by the contractor with a peer review conducted and documented by the Resident Engineer and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.
 4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Resident Engineer.
- D. For work on existing stations, arrange, phase and perform work to assure electrical service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

- F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.10 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.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers (starters), fused and unfused safety switches, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
- B. 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.
- C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm²), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited

approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

1.12 SUBMITTALS

- A. Submit 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. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and/or attached to the equipment.
 3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 4. Parts list which shall include 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.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
 - 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. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of 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 coupling, bushing and termination fitting.
 3. Conduit hangers, clamps and supports.
 4. Duct sealing compound.
 5. Each type of receptacle, toggle switch, occupancy sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 ACCEPTANCE CHECKS AND TESTS

The contractor shall furnish the instruments, materials and labor for field tests.

1.15 TRAINING

- A. Training shall be provided in accordance with Article 1.25, 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 26 05 21
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of the low voltage power and lighting wiring.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-rated construction.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for cables and wiring.
- E. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Installation of low-voltage conductors and cables in manholes and ducts.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

Low voltage cables shall be thoroughly tested at the factory per NEMA WC-70 to ensure that there are no electrical defects. Factory tests shall be certified.

1.5 SUBMITTALS

In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

- 1. Manufacturer's Literature and Data: Showing each cable type and rating.
- 2. Certifications: Two weeks prior to the final inspection, submit four copies of the following certifications to the Resident Engineer:
 - a. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
 - b. Certification by the contractor that the materials have been properly installed, connected, and tested.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.

- B. American Society of Testing Material (ASTM):
 - D2301-04.....Standard Specification for Vinyl Chloride
Plastic Pressure-Sensitive Electrical Insulating
Tape
- C. National Fire Protection Association (NFPA):
 - 70-08.....National Electrical Code (NEC)
- D. National Electrical Manufacturers Association (NEMA):
 - WC 70-09.....Power Cables Rated 2000 Volts or Less for the
Distribution of Electrical Energy
- E. Underwriters Laboratories, Inc. (UL):
 - 44-05.....Thermoset-Insulated Wires and Cables
 - 83-08.....Thermoplastic-Insulated Wires and Cables
 - 467-071.....Electrical Grounding and Bonding Equipment
 - 486A-486B-03.....Wire Connectors
 - 486C-04.....Splicing Wire Connectors
 - 486D-05.....Sealed Wire Connector Systems
 - 486E-94.....Equipment Wiring Terminals for Use with Aluminum
and/or Copper Conductors
 - 493-07.....Thermoplastic-Insulated Underground Feeder and
Branch Circuit Cable
 - 514B-04.....Conduit, Tubing, and Cable Fittings
 - 1479-03.....Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with NEMA WC-70 and as specified herein.
- B. Single Conductor:
 - 1. Shall be annealed copper.
 - 2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.
 - 3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.
- C. Insulation:
 - 1. XHHW-2 or THHN-THWN shall be in accordance with NEMA WC-70, UL 44, and UL 83.
- D. Color Code:
 - 1. Secondary service feeder and branch circuit conductors shall be color-coded as follows:

208/120 volt	Phase	480/277 volt
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Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

- a. Lighting circuit "switch legs" and 3-way switch "traveling wires" shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC.
Coordinate color coding in the field with the Resident Engineer.
2. Use solid color insulation or solid color coating for No. 12 AWG and No. 10 AWG branch circuit phase, neutral, and ground conductors.
3. Conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
 - a. Solid color insulation or solid color coating.
 - b. Stripes, bands, or hash marks of color specified above.
 - c. Color as specified using 0.75 in [19 mm] wide tape. Apply tape in half-overlapping turns for a minimum of 3 in [75 mm] for terminal points, and in junction boxes, pull-boxes, troughs, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.
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. Aboveground Circuits (No. 10 AWG and smaller):
 1. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220° F [105° 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 manufacturer's packaging, shall be strictly followed.
- C. Aboveground Circuits (No. 8 AWG and larger):
 1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.

2. Field-installed compression connectors for cable sizes 250 kcmil and larger shall have not fewer 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. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

D. Underground Branch Circuits and Feeders:

1. Submersible connectors in accordance with UL 486D, rated 600 V, 190° F [90° C], with integral insulation.

2.3 CONTROL WIRING

- A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified for power and lighting wiring, except that the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

2.4 WIRE LUBRICATING COMPOUND

- A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install in accordance with the NEC, and as specified.
- B. Install all wiring in raceway systems.
- C. Splice cables and wires only in outlet boxes, junction boxes, pull-boxes, manholes, or handholes.
- D. Wires of different systems (e.g., 120 V, 277 V) shall not be installed in the same conduit or junction box system.
- E. Wires of different systems (e.g., emergency, and normal power) shall not be installed in the same conduit or junction box system.
- F. 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.
- G. For panel boards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- H. 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.

I. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables. Use lubricants approved for the cable.
2. Use nonmetallic ropes 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. All cables in a single conduit shall be pulled simultaneously.
5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

J. No more than three single-phase branch circuits shall be installed in any one conduit.

3.2 SPLICE INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque values.
- C. 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 FEEDER IDENTIFICATION

- A. In each interior pull-box and junction box, install metal tags on all circuit cables and wires to clearly designate their circuit identification and voltage. The tags shall be the embossed brass type, 1.5 in [40 mm] in diameter and 40 mils thick. Attach tags with plastic ties.

3.4 EXISTING WIRING

Unless specifically indicated on the plans, existing wiring shall not be reused for a new installation.

3.5 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 panel boards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.

3.6 CONTROL AND SIGNAL SYSTEM WIRING IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.7 ACCEPTANCE CHECKS AND TESTS

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices, such as fixtures, motors, or appliances. Test each conductor with respect to adjacent conductors and to ground. Existing conductors to be reused shall also be tested.
- B. Applied voltage shall be 500VDC for 300-volt rated cable, and 1000VDC for 600-volt rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300-volt rated cable and 100 megohms for 600-volt rated cable.
- C. Perform phase rotation test on all three-phase circuits.
- D. The contractor shall furnish the instruments, materials, and labor for all 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 the general grounding and bonding requirements for electrical equipment and operations to provide a low impedance path for possible ground fault currents.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as made, supplementary.
- C. 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.
- C. Section 26 22 00, LOW-VOLTAGE TRANSFORMERS: Low voltage transformers.
- D. Section 26 23 00, LOW-VOLTAGE SWITCHGEAR: Low voltage switchgear.
- E. Section 26 24 11, DISTRIBUTION SWITCHBOARDS: Low voltage distribution switchboards.
- F. Section 26 24 16, PANELBOARDS: Low voltage panelboards.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Clearly present enough information to determine compliance with drawings and specifications.
 - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.

- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
1. Certification that the materials and installation are in accordance with the drawings and specifications.
 2. Certification by the contractor that the complete installation has been properly installed and tested.

1.5 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 designation only.

- A. American Society for Testing and Materials (ASTM):
- B1-07.....Standard Specification for Hard-Drawn Copper Wire
- B3-07.....Standard Specification for Soft or Annealed Copper Wire
- B8-04.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- 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
- C2-07.....National Electrical Safety Code
- C. National Fire Protection Association (NFPA):
- 70-08.....National Electrical Code (NEC)
- 99-2005.....Health Care Facilities
- D. Underwriters Laboratories, Inc. (UL):
- 44-05Thermoset-Insulated Wires and Cables
- 83-08Thermoplastic-Insulated Wires and Cables
- 467-07Grounding and Bonding Equipment
- 486A-486B-03Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 44 or UL 83 insulated stranded copper, except that sizes No. 10 AWG [6 mm²] and smaller shall be solid copper. Insulation color shall be continuous green for all

equipment grounding conductors, except that wire sizes No. 4 AWG [25 mm²] and larger shall be identified per NEC.

- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes No. 10 AWG [6 mm²] and smaller shall be ASTM B1 solid bare copper wire.
- C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

2.2 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.

PART 3 - EXECUTION

3.1 GENERAL

- A. Ground in accordance with the NEC, as shown on drawings, and as specified herein.
- B. System Grounding:
 - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic structures, including ductwork and building steel, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.
- D. Special Grounding: For patient care area electrical power system grounding, conform to NFPA 99 and NEC.

3.2 RACEWAY

- A. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
 - 3. Conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.

4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a bare grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
- D. Wireway Systems:
1. Bond the metallic structures of wireway to provide 100% electrical continuity throughout the wireway system, by connecting a No. 6 AWG [16 mm²] bonding jumper at all intermediate metallic enclosures and across all section junctions.
 2. Install insulated No. 6 AWG [16 mm²] bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 50 ft [16 M].
 3. Use insulated No. 6 AWG [16 mm²] bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
 4. Use insulated No. 6 AWG [16 mm²] bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 49 ft [15 M].
- E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.
- F. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

3.3 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary

for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.

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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. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.
- B. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- C. Section 09 91 00, PAINTING: Identification and painting of conduit and other devices.
- D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

- A. Manufacturer's Literature and Data: Showing each cable type and rating. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Shop Drawings:
 - 1. Size and location of main feeders.
 - 2. Size and location of panels and pull-boxes.
 - 3. Layout of required conduit penetrations through structural elements.
- C. Certifications:
 - 1. Two weeks prior to the final inspection, submit four copies of the following certifications to the Resident Engineer:

- a. Certification by the manufacturer that the material conforms to the requirements of the drawings and specifications.
- b. Certification by the contractor that the material has been properly installed.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American National Standards Institute (ANSI):
C80.1-05.....Electrical Rigid Steel Conduit
- C. National Fire Protection Association (NFPA):
70-08.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
1-05.....Flexible Metal Conduit
5-04.....Surface Metal Raceway and Fittings
6-07.....Electrical Rigid Metal Conduit - Steel
360-093.....Liquid-Tight Flexible Steel Conduit
467-07.....Grounding and Bonding Equipment
514A-04.....Metallic Outlet Boxes
514B-04.....Conduit, Tubing, and Cable Fittings
514C-96.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
- E. National Electrical Manufacturers Association (NEMA):

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 0.5 in [13 mm] unless otherwise shown. Where permitted by the NEC, 0.5 in [13 mm] flexible conduit may be used for tap connections to recessed lighting fixtures.
- B. Conduit:
 - 1. Rigid steel: Shall conform to UL 6 and ANSI C80.1.
 - 2. Liquid-tight flexible metal conduit: Shall conform to UL 360.
- C. Conduit Fittings:
 - 1. Rigid steel conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.

- d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - f. Sealing fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
- 2. Liquid-tight flexible metal conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
 - 3. Surface metal raceway fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
 - 4. Expansion and deflection couplings:
 - a. Conform to UL 467 and UL 514B.
 - b. Accommodate a 0.75 in [19 mm] deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 - c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
- 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.

2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 3. Multiple conduit (trapeze) hangers: Not less than 1.5 x 1.5 in [38 mm x 38 mm], 12-gauge steel, cold-formed, lipped channels; with not less than 0.375 in [9 mm] diameter steel hanger rods.
 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
 2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
 3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
 4. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.

PART 3 - EXECUTION

3.1 PENETRATIONS

- A. Cutting or Holes:
1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the Resident Engineer prior to drilling through structural elements.
 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except where permitted by the Resident Engineer as required by limited working space.
- B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight, as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

- A. In accordance with UL, NEC, as shown, and as specified herein.
- B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where shown on drawings.
- C. Install conduit as follows:

1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut square, ream, remove burrs, and draw up tight.
6. Independently support conduit at 8 ft [2.4 M] on centers. Do not use other supports, i.e., suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts.
7. Support within 12 in [300 mm] of changes of direction, and within 12 in [300 mm] of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
9. 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.
10. Conduit bodies shall only be used for changes in direction, and shall not contain splices.

D. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown on drawings.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the Resident Engineer.

3.3 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms and the tunnel.

- B. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits indiscriminately in the system is prohibited.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 8 ft [2.4 M] intervals.
- F. Surface metal raceways: Use only where shown.
- G. Painting:
 - 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
 - 2. Paint all conduits containing cables rated over 600 V safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 2 in [50 mm] high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 20 ft [6 M] intervals in between.

3.5 WET OR DAMP LOCATIONS

- A. Unless otherwise shown, use conduits of rigid steel.
- B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.

3.6 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water. Provide a green equipment grounding conductor with flexible metal conduit.

3.7 EXPANSION JOINTS

- A. Conduits 3 in [75 mm] and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 3 in [75 mm] with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 5 in [125 mm] vertical drop midway between the ends. Flexible conduit shall have a bonding

jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for conduits 15 in [375 mm] and larger are acceptable.

- C. Install expansion and deflection couplings where shown.
- 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 15 in [375 mm] of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

3.8 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 200 lbs [90 kg]. Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 0.25 in [6 mm] bolt size and not less than 1.125 in [28 mm] embedment.
 - b. Power set fasteners not less than 0.25 in [6 mm] diameter with depth of penetration not less than 3 in [75 mm].
 - c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.
- E. Hollow Masonry: Toggle bolts.
- F. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- G. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- H. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- I. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- J. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.

- K. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.9 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush-mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 24 in [600 mm] center-to-center lateral spacing shall be maintained between boxes.
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 4 in [100 mm] square x 2.125 in [55 mm] deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."
- G. On all branch circuit junction box covers, identify the circuits with black marker.

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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.
- 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 control, submit the following information.
 - 1. Manufacturer's catalog data.
 - 2. Wiring schematic and connection diagram.
 - 3. Installation details.
- C. Manuals:
 - 1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
 - 2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the Resident Engineer.
- D. Certifications:
 - 1. Two weeks prior to final inspection, submit four copies of the following certifications to the Resident Engineer:
 - a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Green Seal (GS):
GC-12.....Occupancy Sensors
- C. Illuminating Engineering Society of North America (IESNA):
IESNA LM-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
- E. Underwriters Laboratories, Inc. (UL):
20.....Standard for General-Use Snap Switches
773.....Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting
773ANonindustrial Photoelectric Switches for Lighting Control
98.....Enclosed and Dead-Front Switches
917.....Clock Operated Switches

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

- A. Wall- or ceiling-mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1 to 15 minute adjustable time delay for turning lights off.
 2. Sensor Output: Contacts rated to operate the connected relay. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Manual/automatic selector switch.
 8. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.
- B. Dual-technology Type: Ceiling mounting; combination PIR and ultrasonic detection methods, field-selectable.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch [150mm] minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. [232 sq. cm], and detect a person of average size and weight moving not less than 12 inches [305 mm] in either a horizontal or a vertical manner at an approximate speed of 12 inches/s [305 mm/s].
 3. Detection Coverage: as scheduled on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.
- B. Aim outdoor photocell switch according to manufacturer's recommendations. Set adjustable window slide for 1 footcandle photocell turn-on.
- C. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer's recommendations.
- D. Set occupancy sensor "on" duration to 10 minutes.
- E. Locate light level sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the scheduled light level at the typical work plane for that area.
- F. Label time switches and contactors with a unique designation.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations.
- B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.
- C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.
- D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function.

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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 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. 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 COTR: 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 COTR: Certification by the Contractor that the devices comply with the drawings and specifications, and have been properly installed, aligned, 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. 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., and conform to NEMA WD 6.
 - 1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
 - 2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four min.) and side wiring from four captively held binding screws.
- B. Duplex Receptacles: 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 brown phenolic compound supported by a plated steel mounting strap haling plaster ears.
 - 2. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, 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.

3. 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.
- 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 plaster 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 WALL PLATES

- A. Wall plates for switches and receptacles shall be type smooth nylon. Oversize plates are not acceptable.
- B. Color shall be ivory unless otherwise specified.
- C. 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.
- D. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- E. Wall plates for data, telephone or other communication outlets shall be as specified in the associated specification.

F. Duplex Receptacles on Emergency Circuit:

1. Bodies shall be red in color. Wall plates shall be red with the word "EMERGENCY" engraved in 6 mm, (1/4 inch) white letters.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. 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 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 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for seismic restraint for nonstructural Components.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- E. Section 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. Energy efficiency data.
 - 6. Photometric data based on laboratory tests complying with IESNA Lighting Measurements, testing and calculation guides.
 - 7. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours) and color temperature (degrees Kelvin).

8. 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. National Fire Protection Association (NFPA):
 - 70.....National Electrical Code (NEC)
 - 101.....Life Safety Code
- C. National Electrical Manufacturer's Association (NEMA):
 - C82.1-97.....Ballasts for Fluorescent Lamps - Specifications
 - C82.2-02.....Method of Measurement of Fluorescent Lamp Ballasts
 - C82.11-02.....High Frequency Fluorescent Lamp Ballasts
- D. 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
 - 924-95.....Emergency Lighting and Power Equipment
 - 935-01.....Fluorescent-Lamp Ballasts
 - 1598-00.....Luminaires
- F. Federal Communications Commission (FCC):
 - Code of Federal Regulations (CFR), Title 47, Part 18

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. 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.
 - 2. High Intensity Discharge (H.I.D.): Shall have porcelain enclosures.
- E. 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.
- F. Metal Finishes:
 - 1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of

- stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
 3. Exterior finishes shall be as shown on the drawings.
- G. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
- H. Light Transmitting Components for Fluorescent Fixtures:
1. Shall be 100 percent virgin acrylic.
 2. Flat lens panels shall have not less than 1/8 inch [3.2mm] of average thickness. The average thickness shall be determined by adding the maximum thickness to the minimum unpenetrated thickness and dividing the sum by 2.
 3. 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 programmed-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 (T5 lamps only).
 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: 0.87 or higher unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
 10. Interference: Comply with 47 CFT 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 color temperature between 3500° and 4100°K, 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
- B. Long Twin-Tube Fluorescent Lamps:
 1. T5, CRI 80 (minimum), color temperature between 3500° and 4100°K, 20,000 hours average rated life.
- C. High Intensity Discharge Lamps:
 1. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900°K, and average rated life of 24,000 hours, minimum.

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. Maximum fixture wattage shall be 1 watt or less.
 2. 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.
 3. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
 4. 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. 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.

5. 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.
 6. 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. 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.
 - I. 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.
 - J. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

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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. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.5 EQUIPMENT REQUIREMENTS

Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.6 EQUIPMENT PROTECTION

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
 1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
 2. Damaged equipment shall be, as determined by the Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
 3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.7 WORK PERFORMANCE

- A. Job site safety and worker safety is the responsibility of the contractor.
- B. For work on existing stations, arrange, phase and perform work to assure communications service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to

its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

- D. Coordinate location of equipment and pathways with other trades to minimize interferences. See the GENERAL CONDITIONS.

1.8 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Inaccessible Equipment:
 - 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 - 2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.9 EQUIPMENT IDENTIFICATION

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

1.10 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION_____".

2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 3. Submit each section separately.
- E. The submittals shall include the following:
1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 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.

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 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. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- B. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- C. General electrical requirements and items that is common to more than one section of Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

1.3 SUBMITTALS

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

- A. Shop Drawings:
 - 1. Size and location of panels and pull boxes
 - 2. Layout of required conduit penetrations through structural elements.
 - 3. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Certification: Prior to final inspection, deliver to the 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
 - 50-03.....Enclosures for Electrical Equipment

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
797-03.....	Electrical Metallic Tubing

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. 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.
 3. Surface Metal Raceway: Shall conform to UL5.
- C. Conduit Fittings:
 1. Rigid steel conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
 2. Electrical metallic tubing fittings:
 - a. Fittings 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.
3. Surface Metal Raceway Fittings: As recommended by Raceway Manufacturer.
4. 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.

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, 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, COTR as required by limited working space.

B. Fire Stop: Where conduits, wireways, and other communications raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

A. Install conduit as follows:

1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically continuous.
6. Independently support conduit at 8'0" on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Conduit installations under fume and vent hoods are prohibited.

10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.

11. Do not use aluminum conduits in wet locations.

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. 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 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms, tunnel.

B. Conduit for Conductors 600 volts and below:

1. Rigid steel, IMC, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.

C. Align and run conduit parallel or perpendicular to the building lines.

D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.

E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.

F. Surface metal raceways: Use only where shown.

G. Painting:

1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.4 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.

3.5 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.

3.6 BOX INSTALLATION

- A. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- B. 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.
- C. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

3.7 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 pull wire in all empty conduits. (Sleeves through floor are exceptions).

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**SECTION 27 10 00
STRUCTURED CABLING**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of the structured cabling system to provide a comprehensive telecommunications infrastructure.

1.2 RELATED WORK

- A. 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.

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. Install all wiring in raceway systems.
- B. 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.

3.4 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.

- - - E N D - - -

SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies the furnishing, installing, certification, testing, and guaranty of a complete and operating Voice and Digital Cable Distribution System (here-in-after referred to as "*the System*"), and associated equipment and hardware 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: 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: telecommunications outlets (TCO); "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 support the following operating parameters:

a. 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.

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.

1.3 APPLICABLE PUBLICATIONS

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

designation only. Except for a specific date given the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date the system's submittal is technically approved by VA, shall be enforced.

B. National Fire Protection Association (NFPA):

70	NATIONAL ELECTRICAL CODE (NEC)
75	Protection of Electronic Computer/Data Processing Equipment
77	Recommended Practice on Static Electricity
	Standard for Health Care Facilities
101	Life Safety Code
1221	Emergency Services Communication Systems

C. Underwriters Laboratories, Inc. (UL):

65	Wired Cabinets
467	Grounding and Bonding Equipment
497/497A/497B	PROTECTORS FOR PAIRED CONDUCTORS/ COMMUNICATIONS CIRCUITS/DATA COMMUNICATIONS AND FIRE ALARM CIRCUITS

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. International Telecommunication Union - Telecommunication Standardization Sector (ITU-T).

F. Federal Information Processing Standards (FIPS) Publications.

G. Federal Communications Commission (FCC) Publications: Standards for telephone equipment and systems.

- H. Joint Commission on Accreditation of Health Care Organization (JCAHO): Comprehensive Accreditation Manual for Hospitals.
- I. 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 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. 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. Provide all material and appurtenances for a complete and operating system.
 5. Pictorial layouts of each TCO as each is expected to be installed and configured.
 6. Engineering drawings of the System, showing proposed TCO values, and signal level at each TCO multipin.
 7. List of test equipment as per paragraph 1.5.D. below.
 8. Letter certifying that the Contractor understands the requirements of the SAMPLES Paragraph 1.5.E.
 9. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning acceptance 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. 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.
- D. 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. Two each telephone (or voice) rj45 jack installed.
 - b. Two each multi pin data rj45 jacks installed.
 - c. Cover Plate installed.
 2. 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.
- E. Certifications:
1. Submit written certification from the OEM indicating that the proposed supervisor of the installation and the proposed provider of the contract maintenance are authorized representatives of the OEM. Include the individual's exact name and address and OEM credentials in the certification.
 2. Submit written certification from the OEM that the wiring and connection diagrams meet National and/or Government Life Safety Guidelines, NFPA, NEC, UL, this specification, and JCAHCO requirements and instructions, requirements, recommendations, and guidance set forth by the OEM for the proper performance of the

System as described herein. The VA 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.

F. 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. 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
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3. Telecommunication Outlets: The Contractor shall clearly and fully indicate this category for each outlet location and compare the total count to the locations identified above as a part of the technical submittal. Additionally, the Contractor shall indicate the total number of spares.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. System Requirements:

1. 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. The System shall be capacity sized so that loss of connectivity to external telephone systems shall not affect the Facilities operation in specific designated locations. The System shall:
 - a. Be capable of inter-connecting and functioning fully with the existing Local Telephone Exchange (LEC) Network(s), Federal Telephone System (FTS) Inter-city Network(s), Inter-exchange Carriers, Integrated Services Digital Network (ISDN), Electronic Private Branch Exchange (EPBX) switches, asynchronous/synchronous data terminals and circuits including Automatic Transfer Mode (ATM), Frame Relay, and local area networks (LAN), at a minimum.
 - b. Be a voice and data cable distribution system that is based on a physical "Star" Topology.
2. Cable Systems - Twisted Pair Coaxial:
 - a. General:
 1. The Contractor shall be responsible for providing a new system conforming to current and accepted telephone and digital 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 when specifically approved, flexible innerduct. It is the responsibility of the Contractor to confirm all contract drawings and the Facility's physical layout to determine the necessary cable protective devices 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 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 RE and the IRM or COTR to provide all cable pairs/circuits from the Facility Telephone Switch Room and establish circuits throughout the Facility for all voice, data, computer alarm (except fire alarm), PA, LAN, DHCP, and any low voltage circuits as described herein.
 13. The Contractor shall provide proper test equipment to guarantee that cable pairs and 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.
- b. 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).
- c. Telecommunication Outlets (TCO), Jacks: All TCO's shall have a minimum of four (4) 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.
- d. 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.

B. 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.
2. 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.
3. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.
4. All interconnecting twisted pair, 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, cable unterminated, unconnected, loose or unsecured.
5. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, and this document, which ever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance. Reference Specification Section 27 10 00, STRUCTURED CABLING..

6. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cyclac plastic for the areas where provided.

2.2 DISTRIBUTION EQUIPMENT AND SYSTEMS

A. Telecommunication Outlet (TCO):

1. The TCO shall consist of one telephone multipin jack and two data multipin jacks, and one single mode fiber optic, and one multimode fiber optic or 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.
3. The TCO shall be fed from the appropriate CCS located in the respective RTC in a manner to provide a uniform and balanced distribution system.
4. Interface of the data multipin jacks to appropriate patch panels (or approved "punch down" blocks) in the associated RTC, is the responsibility of the Contractor. The Contractor shall not extend data cables from the RTCs to data terminal equipment or install data terminal equipment.
5. The wall outlet shall be provided with a stainless steel or approve alternate cover plate to fit the telephone multipin jack, data multi-pin jacks, fiber optic jacks, and the outlet box provided (100mm (4in.) x 100mm (4in.) for single and 100mm (4in.) x 200mm (8in.) for dual outlet box applications). For PBPU installations, the cover plate shall be stainless steel.

- ### B. Distribution Cables:
- Each cable shall meet or exceed the following specifications for the specific type of cable. Each cable reel shall be sweep tested and certified by the OEM by tags affixed to each reel. The Contractor shall turn over all sweep tags to the 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. 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

2. 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

C. 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

2.3 INSTALLATION KIT

The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, 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, and twisted pair cable reels, conduit, and/or cable duct bundles, wire rolls, physical installation hardware. The following are the minimum required installation sub-kits:

- A. 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.
- B. 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.
- C. 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.

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. 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.
4. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
5. All vertical and horizontal copper cables shall be terminated so any future changes only requires modifications of the existing EPBX or signal closet equipment only.

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, 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 to be installed in partitioned cable tray with data cables may be granted in writing by the RE if requested.) Conduits shall be provided in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and NEC Articles 517 for Critical Care and 800 for Communications systems, at a minimum.

- c. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
 - d. When "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.
- 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. 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 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.
 - b. 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.
 - c. 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.
 - d. 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).
 - e. 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.

- f. 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.
- g. Cable runs shall be splice free between conduit junction and interface boxes and equipment locations.
- h. 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.
- i. 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.
- j. Completely test all of the cables after installation and replace any defective cables.
- k. Wires or cables installed outside of conduit, cable trays, wireways, cable duct, etc.
 - 1) Only when specifically authorized as described herein, will wires or cables be identified and approved to be installed outside of conduit. The wire or cable runs shall be UL rated plenum and OEM certified for use in air plenums.
 - 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 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.

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.

G. AC Power: AC power wiring shall be run separately from signal cable.

H. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for voice and data circuits shall be stenciled using laser printers. Handwritten labels are not acceptable.

1. Cable and Wires (Hereinafter referred to as "Cable"): Cables shall be labeled at both ends in accordance with ANSI/EIA/TIA-606-A. Labels shall be permanent in contrasting colors. Cables shall be identified according to the System "Record Wiring Diagrams".

2. 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.
3. 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. 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.
3. 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.
4. 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) Signal Level at 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. Performance Testing:
1. Perform Category 6, 5, 5e 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.

- E. Total System Acceptance Test: The Contractor shall perform verification tests for UTP STP copper cabling system(s) and the multimode and single mode 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 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. 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 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.

b) Contractor Log: The Contractor shall maintain a separate log entry for each item 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 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 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 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.

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.

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 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. Excavation and backfill for cables that are installed in conduit:
Section 31 20 00, EARTH MOVING.
- B. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- C. General electrical requirements that are common to more than one section in Division 28: Section 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.
- D. Conduits for cables and wiring: Section 28 05 33, RACEWAYS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY.
- E. 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 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, 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.

3.4 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.

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.

2.2 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).

2.3 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.

2.4 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).

2.5 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.

PART 3 - EXECUTION**3.1 GENERAL**

- A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.
- B. 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 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. Bedding of conduits: Section 31 20 00, EARTH MOVING.
- B. Mounting board for communication closets: Section 06 10 00, ROUGH CARPENTRY.
- C. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- D. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.
- F. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- G. General electrical requirements and items that is common to more than one section of Division 28: Section 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.
- H. 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
- 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. Flexible galvanized steel conduit: Shall Conform to UL 1.
 3. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
- C. Conduit Fittings:
1. Rigid steel conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.

- b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - e. 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.
- 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.

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 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.
 12. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

B. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

C. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the Resident Engineer.

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 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors 600 volts and below:
 1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- F. Surface metal raceways: Use only where shown.
- G. Painting:
 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
 2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.4 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.

3.5 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.

3.6 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.

3.7 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 pull wire in all empty conduits. (Sleeves through floor are exceptions).

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SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring as shown on the drawings and specified.
- B. Fire alarm systems shall comply with requirements of NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the Contracting Officer or his authorized representative. Installers shall have a minimum of two years experience installing fire alarm systems.
- C. The main fire alarm control unit shall automatically transmit alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NFPA 72.

1.2 SCOPE

- A. New fire alarm devices shall be installed and connected to the new emergency department fire alarm system in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification. The new fire alarm control panel shall be connected to the existing main hospital control panel.
- B. Basic Performance:
 - 1. Alarm and trouble signals from each building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
 - 2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed five (5) seconds.

3. Initiating device circuits (IDC) shall be wired Style C in accordance with NFPA 72.
4. Signaling line circuits (SLC) within buildings shall be wired Style 4 in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet of floor space or 3 floors whichever is less.
5. Notification appliance circuits (NAC) shall be wired Style Y in accordance with NFPA 72.

1.3 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: Restoration of existing surfaces.
- 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-Holder.
- 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. Drawings:
 1. Prepare drawings using AutoCAD Release 14 software and include all contractors information. Layering shall be by VA criteria as provided by the Contracting Officer's Technical Representative (COTR). Bid drawing files on AutoCAD will be provided to the Contractor at the pre-construction meeting. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.
 2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and raceway

routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.

3. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.
4. 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 14 or later). 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, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
 - a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.
 - b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
 - c. Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.
 - d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturer's installation limitations including but not limited to circuit length limitations.
 - e. Complete listing of all digitized voice messages.
 - f. 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.
 - j. 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 manual approval.
 - b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.
 - c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.
 - d. Certificate of Installation as required by NFPA 72 for each building. The certificate shall identify any variations from the National Fire Alarm Code.
 - e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.

D. Certifications:

- 1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.

2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

1.5 WARRANTY

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of five (5) years from the date of acceptance of the entire installation by the Contracting Officer.

1.6 GUARANTY PERIOD SERVICES

- A. Complete inspection, testing, maintenance and repair service for the fire alarm system shall be provided by a factory trained authorized representative of the manufacturer of the major equipment for a period of 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 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 two 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. 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.

1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only.
- B. National Fire Protection Association (NFPA):
 70-2005.....National Electrical Code (NEC).
 72-2002.....National Fire Alarm Code.
 90A-2002.....Installation of Air Conditioning and Ventilating Systems.
 101-2003.....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) 2003 Edition

PART 2 - PRODUCTS**2.1 EQUIPMENT AND MATERIALS, GENERAL**

- A. Except as indicated in paragraph A above, All equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturer's requirements and that satisfactory total system operation has been achieved.

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 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 new wiring shall be 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 and wiring used for the multiplex communication loop shall be twisted and shielded unless specifically excepted by the fire alarm equipment manufacturer in writing.
 4. 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.
 5. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.
- C. Terminal Boxes, Junction Boxes, and Cabinets:
1. Shall be galvanized steel in accordance with UL requirements.
 2. All new boxes shall be sized and installed in accordance with NFPA 70.
 3. New 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. Connect new devices to existing fire alarm control panel located in room E111 on the first floor of the emergency department.

2.4 ALARM NOTIFICATION APPLIANCES

A. Bells:

1. Shall be electric, single-stroke or vibrating, heavy-duty, under-dome, solenoid type.
2. Unless otherwise shown on the drawings, shall be 150 mm (6 inches) diameter and have a minimum nominal rating of 80 dBA at 3000 mm (10 feet).

3. Mount on removable adapter plates on outlet boxes.
4. Bells located outdoors shall be weatherproof type with metal housing and protective grille.
5. Each bell circuit shall have a minimum of twenty percent spare capacity.

B. Speakers:

1. Shall operate on either 25 VRMS or 70.7 VRMS with field selectable output taps from 0.5 to 2.0W and originally installed at the 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.

C. Strobes:

1. Xenon flash tube type minimum 15 candela in toilet rooms and 75 candela in all other areas with a flash rate of 1 HZ. Strobes shall be synchronized where required by the National Fire Alarm Code (NFPA 72).
2. Backplate shall be red with 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.

D. Fire Alarm Horns:

1. Shall be electric, utilizing solid state electronic technology operating on a nominal 24 VDC.
2. Shall be a minimum nominal rating of 80 dBA at ten feet.
3. Mount on removable adapter plates on conduit boxes.
4. Horns located outdoors shall be of weatherproof type with metal housing and protective grille.
5. Each horn circuit shall have a minimum of twenty (20) percent spare capacity.

2.5 ALARM INITIATING DEVICES

A. Manual Fire Alarm Stations:

1. Shall be non-breakglass, address reporting type.
2. Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.

3. Stations shall be of single action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE".
4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
5. Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.

B. Smoke Detectors:

1. Smoke detectors shall be UL listed for use with the fire alarm control unit being furnished.
2. Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be installed in accordance with the manufacturer's recommendations and NFPA 72.
3. Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.
4. All spot type and duct type detectors installed shall be of the photoelectric type.
5. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
6. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.

C. Heat Detectors:

1. Heat detectors shall be of the addressable restorable rate compensated fixed-temperature spot type.
2. Detectors shall have a minimum smooth ceiling rating of 2500 square feet.
3. Ordinary temperature (135 degrees F) heat detectors shall be utilized in elevator shafts and elevator mechanical rooms. Intermediate temperature rated (200 degrees F) heat detectors shall be utilized in all other areas.

4. Provide a remote indicator lamp, key test station and identification nameplate (e.g. "Heat Detector - Elevator P-_____) for each elevator group. Locate key test station in plain view on elevator machine room wall.

D. 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. Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches added. Connect all switches shown on the approved shop drawings.
3. All new switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Timing shall be recorded and documented during testing.

2.6 ADDRESS REPORTING INTERFACE DEVICE

- A. Shall have unique addresses that reports directly to the building fire alarm panel.
- B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.
- C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.
- D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.
- E. Shall be mounted in weatherproof housings if mounted exterior to a building.

2.7 SPARE AND REPLACEMENT PARTS

- A. Provide spare and replacement parts as follows:
 1. Manual pull stations - 2
 2. Heat detectors - 2 of each type
 3. Fire alarm strobes - 2
 4. Fire alarm bells - 2
 5. Fire alarm speakers - 2
 6. Smoke detectors - 10
 7. Duct smoke detectors with all appurtenances - 1
 8. Sprinkler system water flow switch - 1 of each size
 9. Sprinkler system water pressure switch - 1 of each type
 10. Sprinkler valve tamper switch - 1 of each type
 11. Control equipment utility locksets - 5

12. Control equipment keys - 25
 13. 2.5 oz containers aerosol smoke - 12
 14. Printer paper - 3 boxes
 15. Printer replacement ribbons - 3
 16. Monitor modules - 3
 17. Control modules - 3
 18. 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.

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.
- C. All new exposed conduit shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.
- D. 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.
- E. Speakers may be surface mounted in unfinished areas.
- F. Strobes shall be flush wall mounted 2,000 mm (80 inches) above the floor or 150 mm (6 inches) below ceiling, whichever is lower. Locate and mount to maintain a minimum 900 mm (36 inches) clearance from side obstructions.
- G. 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.

3.2 TYPICAL OPERATION

- A. Activation of any manual pull station, or smoke detector shall cause the following operations to occur:
 - 1. Operate the emergency voice communication system in the Buildings.
For sprinkler protected buildings, flash strobes continuously only in the zone of alarm. For buildings without sprinkler protection throughout, flash strobes continuously only on the floor of alarm.
 - 2. Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control unit in the Building.
 - 3. Release only the magnetic door holders in the smoke zone on the floor from which alarm was initiated after the alert signal.
 - 4. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
 - 5. Unlock the electrically locked exit doors within the zone of alarm.
- B. Heat detectors in elevator machine rooms shall, in addition to the above functions, disconnect all power to all elevators served by that machine room after a time delay. The time delay shall be programmed within the fire alarm system programming and be equal to the time it takes for the car to travel from the highest to the lowest level, plus 10 seconds.
- C. Operation of a smoke detector at a corridor door used for automatic closing shall also release only the magnetic door holders on that floor in that smoke zone. Operation of a smoke detector at a shutter used for automatic closing shall also release only the shutters on that floor in that smoke zone.
- D. 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.
- E. 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, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COTR.
- B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COTR. When any defects are detected, make repairs or install replacement components, and repeat the tests until

such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the COTR, the contractor may request a final inspection.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
4. Open each alarm initiating and notification circuit to see if trouble signal actuates.
5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

3.4 FINAL INSPECTION AND ACCEPTANCE

- A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.
- B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

PART 4 - SCHEDULES

4.1 SMOKE ZONE DESCRIPTIONS:

- A. Refer to architectural drawings for smoke zones.

4.2 DIGITIZED VOICE MESSAGES:

- A. Digitized voice messages shall be provided for each smoke zone of the Building. 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 floor in alarm, and the floor below.

- - - END - - -

SECTION 31 20 00
SITE EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for **SITE** 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.
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. For excavation related to building construction see **SECTION 31 23 01 STRUCTURAL EXCAVATION, BACKFILL, & COMPACTION (BUILDING AREA)**
- B. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- C. Safety requirements /Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.
- F. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, and Section 32 90 00, PLANTING.
- G. Site preparation: Section 31 23 19
- H. Paving sub-grade requirements: Section 32 12 16, ASPHALT PAVING.

1.4 CLASSIFICATION OF EXCAVATION:

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.
- B. Rock Excavation:
1. Trenches and Pits: Removal and disposal of solid, homogenous, interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be excavated with a late-model, track-mounted hydraulic excavator; equipped with a 1050 mm (42 inch) wide, short-tip-radius rock bucket; rated at not less than 103 kW (138 hp) flywheel power with bucket-curling force of not less than 125 kN (28,090 lbf) and stick-crowd force of not less than 84.5 kN (19,000 lbf); measured according to SAE J-1179. Trenches in excess of 3000 mm (10 feet) wide and pits in excess of 9000 mm (30 feet) in either length or width are classified as open excavation.
 2. Open Excavation: Removal and disposal of solid, homogenous, interlocking crystalline material firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be dislodged and

- excavated with a late-model, track-mounted loader; rated at not less than 157 kW (210 hp) flywheel power and developing a minimum of 216 kN (48,510 lbf) breakout force; measured according to SAE J-732.
3. Other types of materials classified as rock are unstratified masses, conglomerated deposits and boulders of rock material exceeding 0.76 m³ (1 cubic yard) for open excavation, or 0.57 m³ (3/4 cubic yard) for footing and trench excavation that cannot be removed by rock excavating equipment equivalent to the above in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted.
 4. Blasting: Removal and disposal of solid, homogenous, interlocking crystalline material firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be removed with conventional methods may not be performed by blasting.
 5. Definitions of rock and guidelines for equipment are presented for general information purposes only. The Contractor is expected to use the information presented in the Geotechnical Engineering Report to evaluate the extent and competency of the rock and to determine both quantity estimations and removal equipment and efforts.

1.6 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Rock Excavation Report:
 1. Certification of rock quantities excavated.
 2. Excavation method.
 3. Labor.
 4. Equipment.
 5. Land Surveyor's or Civil Engineer's name and official registration stamp.
 6. Plot plan showing elevation.
- C. Furnish to Resident Engineer:
 1. Contactor shall furnish resumes with all personnel involved in the project including Project Manager, Superintendent, and Resident 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 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.

1.7 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - T99-01(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- μ m (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- μ m (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. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from areas within 4500 mm (15 feet) of new construction and 2250 mm (7.5 feet) of utility lines when removal is approved in advance by Resident Engineer. Remove materials from Medical Center. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Do not store building materials closer to trees and shrubs, that are to remain, than farthest extension of their limbs.
- D. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by Resident Engineer. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 0.014 m³ (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the soil will be destroyed.
- E. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately

parallel unless otherwise indicated. Remove material from Medical Center.

- F. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.
1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
 2. Locations of existing and proposed elevations indicated on plans are approximate from a site survey and subsequently generated existing contours and spot elevations. Contractor is responsible to notify Resident Engineer of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify Resident Engineer of any differences between existing or constructed grades, as compared to those shown on the plans.
 3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.
 4. Finish grading is specified in Section 32 90 00, PLANTING.
- G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION:

- A. Shoring, Sheeting and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the Resident Engineer, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.
1. Design of the temporary support of excavation system is the responsibility of the Contractor.
 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, per Section 3.3, 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. Excavation Drainage: Operate pumping equipment and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from Resident Engineer.
- C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with concrete or material approved by the Resident Engineer.
- D. Proofrolling:
1. After rough grade has been established in cut areas and prior to placement of fill in fill areas under building and pavements, proofroll exposed subgrade with a fully loaded dump truck to check for pockets of soft material.
 2. Proofrolling shall consist of at least two complete passes with one pass being in a direction perpendicular to preceding one. Remove any areas that deflect, rut, or pump excessively during proofrolling, or that fail to consolidate after successive passes to suitable soils and replaced with compacted fill. Maintain subgrade until succeeding operation has been accomplished.
- E. 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.

F. 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.

- G. 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 (1/2 inch).
- d. Grading Inside Building Lines: Finish subgrade to a tolerance of 13 mm (1/2 inch) when tested with a 3000 mm (10 foot) straightedge.

3.4 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 to 95 percent compaction rate.
 - b. Curbs, curbs and gutters, ASTM D698 to 95 percent compaction rate.
 - c. Under Sidewalks, scarify and recompact top 150 mm (6 inches) below subgrade and compact each layer of backfill or fill material in accordance with ASTM D698 to 95 percent compaction rate.
 - d. Landscaped areas, top 400 mm (16 inches), ASTM D698 to 85 percent compaction rate.
 - e. Landscaped areas, below 400 mm (16 inches) of finished grade, ASTM D698 to 80 percent compaction rate.
 2. Natural Ground (Cut or Existing)
 - a. Under building slabs, steps and paved areas, top 150 mm (6 inches), ASTM D698 to 95 percent compaction rate.
 - b. Curbs, curbs and gutters, top 150 mm (6 inches), ASTM D698 to 95 percent compaction rate.
 - c. Under sidewalks, top 150 mm (6 inches), ASTM D698 to 95 percent compaction rate.

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 Property .

----- E N D -----

SECTION 31 23 01
STRUCTURAL EXCAVATION, BACKFILL, & COMPACTION (BUILDING AREA)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including general and supplementary conditions and Division 1 specification sections, apply to this section.
1. Refer to Division 1 for applicable local codes and regulations.

1.2 DESCRIPTION OF WORK

- A. This section pertains to an area bounded by 20-foot-minimum outside of and parallel to the exterior walls of the building, including canopies, loading docks, and other structures attached to the building.
- B. This work includes the following:
1. Preparing subgrade for building slabs, walks, and pavements.
 2. Preparing crushed stone for support of building slabs.
 3. Excavating and backfilling for building structure.
 4. Excavating and backfilling of trenches within building lines.
 5. Excavating and backfilling for underground mechanical and electrical utilities and buried mechanical and electrical appurtenances.
 6. Excavating and backfilling for Mechanical/Electrical Work. Refer to mechanical and electrical sections for excavation and backfill required in conjunction with underground mechanical and electrical utilities and buried mechanical and electrical appurtenances.
 7. Final grading and placement and preparation for topsoil for lawns and planting are specified in Division 2.

1.3 QUALITY ASSURANCE

- A. Comply with: New York State Department of Transportation (NYSDOT) "Standard Specifications for Construction and Materials."
- B. Routine testing of existing soils and compacted material for compliance with these specifications will be performed as part of Special Inspections.
1. Compacted material not meeting density requirements shall be removed or recompacted and retested at Contractor's expense.

1.4 SPECIAL INSPECTIONS

- A. Refer to Specification Section 01 45 29 and Schedule of Special Inspections.

1.5 MATERIAL EVALUATION/QUALITY CONTROL

- A. Preconstruction Testing: Contractor shall employ Testing Agency acceptable to Engineer and Architect to perform the following services:
1. Test materials proposed for use by Contractor to verify specified requirements.
 - a. Determine optimum moisture at which maximum density can be obtained in accordance with ASTM D 1557, Modified Proctor.
 - b. Perform particle size analysis in accordance with ASTM D 422.

- B. Submit Testing Agency qualifications demonstrating experience with similar types of projects.
- C. The RDP for Geotechnical Engineering shall perform the following:
 1. Identify soils requiring undercutting and replacement while observing proof rolling and when subgrade is exposed.
 2. Verify footing bearing strata.
 3. Review and accept materials proposed by Contractor for use as compacted fill based on test data and information submitted by preconstruction Testing Agency. Architect shall coordinate review of submittals.
 4. Observe and accept filling and compaction procedures.
 5. Review and approve preparation of slab-on-grade subgrade and crushed stone.
- D. Geotechnical Engineer shall submit copies of reports to Special Inspector, Engineer, Architect, Construction Manager, and Contractor. Include date of site visit, description of work observed, and summary of observations and recommendations.

1.6 SUBMITTALS

- A. Submit to RDP for Geotechnical Engineering:
 1. Gradations for proposed fill materials and mix design proposed for flowable fill at least 15 days before start of backfilling. Flowable fill submittal shall include ASTM C 1260 test results.
 2. Product data, specifications, and installation instructions for proprietary materials.
 3. Material certifications for products specified to conform with NYSDOT references and ASTM references.

1.7 DEFINITIONS

- A. Excavation: Removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.
- B. Unauthorized Excavation: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect. Unauthorized excavation and remedial work directed by Architect shall be at Contractor's expense.
 1. Under footings, tunnel segments, foundation bases, or mat foundations, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to Architect.
 2. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification unless otherwise directed by Architect.
- C. Additional Excavation: If RDP for Geotechnical Engineering determines bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered, and replace excavated material as directed by Geotechnical Engineer.
 1. Removal of unsuitable material and replacement as directed will be paid on basis of conditions of contract relative to changes in work.

- D. Subgrade: Undisturbed earth or compacted soil layer immediately below granular subbase, base of structure, or topsoil materials.
- E. Structure: Buildings, foundations, slabs, or other man-made stationary features occurring above or below ground surface.

1.8 PROJECT CONDITIONS

- A. Site Information: Subsurface investigation reports were used for basis of design and are available to Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.
 - 1. Additional test borings and other exploratory operations may be performed by Contractor at Contractor's option; however, no change in contract sum will be authorized for additional exploration.
- B. Existing Utilities: Locate existing underground utilities in work area before starting earthwork operations. Where utilities are to remain in place, provide adequate means of protection during earthwork operations.
 - 1. If uncharted or incorrectly charted piping or other utilities are encountered during excavation, consult with utility owner and Architect immediately for directions. Cooperate with Owner and public and private utility companies to keep services and facilities in operation. Repair damaged utilities as required by utility owner.
 - 2. Do not interrupt existing utilities serving facilities occupied by Owner or others during occupied hours except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided.
 - a. Provide minimum 48-hours notice to Architect and receive written notice to proceed before interrupting utilities.
 - 3. Demolish and remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.
- C. Use of Explosives: Do not bring explosives onto site or use in work.
- D. Protection of Property: Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - 1. Perform excavation by hand within drip line of large trees to remain. Protect root systems from damage and from drying out to greatest extent possible. Maintain moist condition for root system, and cover exposed roots with moistened burlap.

1.9 PRODUCT HANDLING

- A. Store materials so as to preserve their quality and fitness for work.

1.10 WORKMANSHIP

- A. Contractor shall be responsible for correction of work not conforming to specified requirements. Correct deficient work as directed by Architect.

- B. Remove work found to be defective. Replace with new acceptable work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General Fill Material: Soil materials free of clay, rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- B. Flowable Fill Material: Cementitious, flowable, excavatable, backfill material having a compressive strength of 50 to 100 pounds per square inch (psi) at 28 days. Provide mix that minimizes shrinkage and is non-expansive.
- C. Structural Fill: Sound and durable sand and gravel, free of deleterious materials such as pyritic shale, organics, or contaminants of a chemical, mineral, or biological nature and conforming to the following limits of gradation:

Percent Passing by Weight	Sieve Size
100	3 inch
90 - 100	2 inch
75 - 90	3/4 inch
35 - 65	1/4 inch
5 - 40	No. 40
0 - 8	No. 200

- D. Crushed Stone: Washed crushed stone, ASTM C 33, Blend 57.
- E. Cushion Sand: Comply with requirements of NYSDOT Section 703-06.
- F. Bedding: Comply with the requirements of NYSDOT Section 703-02, material requirements, crushed stone (703-0201).
- G. Filter Fabric: "Geotex 351" by Propex Geosynthetics; "Mirafi 140N" by Mirafi, Inc.; or accepted equivalent.
- H. Soil Stabilization Geotextile: "Geotex 315ST" by Propex Geosynthetics; "Mirafi 600X" by Mirafi, Inc.; or accepted equivalent.
- I. Excavated Materials: Do not use as structural fill. Do not use as general fill material unless accepted by Geotechnical Engineer.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Examine substrates and conditions under which work shall be performed. Do not proceed with work until unsatisfactory conditions are corrected.
- B. Maintain drainage and restrict traffic within building area during construction to maintain integrity of subgrade. Failure to observe these precautions will require Contractor to remove disturbed areas and correct at his expense.

3.2 COLD-WEATHER PROTECTION

- A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.3 REMOVALS

- A. Clear, grub, and strip site of vegetation, topsoil, and other organic materials.

- B. Remove brick fragments and other construction debris. Plow-strip or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material can bond with existing surface.
 - 1. When existing ground surface has a density less than that specified for a particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.
- C. Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash, and debris. Legally dispose off Owner's property.

3.4 PROOF ROLLING

- A. Following stripping and removing miscellaneous fill, grade and compact exposed subgrade. Proof roll subgrade by making five passes across building area in each direction using smooth-drum vibrating roller having static weight of 10 tons minimum.
- B. Under cut soft spots that develop during proof rolling and replace with compacted structural fill. Contractor shall be paid for this work on a unit cost basis.
- C. Do not perform proof rolling during or immediately after periods of inclement weather.

3.5 EXCAVATION

- A. Excavation shall be considered unclassified and understood to mean all materials encountered during excavation.
- B. Excavations shall be laid back or sheeted and braced to prevent sloughing in of sides. Maintain sides and slopes of excavations in stable condition until completion of backfill. Incline cut slopes no steeper than permitted by OSHA standards for excavations in soil type(s) encountered.
- C. Hand trim foundation excavations to remove loose soil or ridges of materials left by equipment.
- D. Keep loose material and debris out of excavations.
- E. Shoring and Bracing: Provide materials for shoring and bracing, including sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.
 - 1. Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the Resident Engineer, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.
 - 2. Design of the temporary support of excavation system is the responsibility of the Contractor. The Contractor shall submit a Shoring and Sheet piling plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and

sheeting of excavations. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3. 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.
4. Shore excavations that are carried below elevations of adjacent existing foundations.
5. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall provide a concrete fill support 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.
6. The Contractor is required to hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan if necessary. The Geotechnical Engineer shall be available to meet with the Resident Engineer at any time throughout the contract duration.

3.6 DEWATERING

- A. Dewatering activities shall conform to Stormwater Pollution Prevention Plan (SWPPP) implemented by site operator if required as a condition of construction permit.
- B. Perform excavation and filling in manner and sequence to provide proper drainage at all times.
- C. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.
 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting of footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components

necessary to convey water away from excavations.

2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rainwater and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

3.7 STORAGE OF EXCAVATED MATERIALS

- A. On-site storage of excavated materials shall conform to Stormwater Pollution Prevention Plan (SWPPP) implemented by site operator if required as condition of construction permit.
- B. Stockpile excavated materials acceptable for reuse. Place, grade, and shape stockpiles for proper drainage.
 1. Locate and retain soil materials away from edges of excavations. Do not store within drip lines of trees indicated to remain.
 2. Dispose of excess excavated soil material and materials not acceptable for use as general fill.

3.8 TRENCH EXCAVATION FOR PIPES AND CONDUIT

- A. Excavate trenches to uniform width sufficiently wide to provide ample working room and minimum of 6 to 9 inches of clearance on both sides of pipe or conduit.
- B. Do not locate trenches that are deeper than adjacent footings closer horizontally to the footing than the vertical distance separating the bottom of trench and bottom of footing.
- C. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
 1. For pipes or conduit less than 6 inches in nominal size and for flat-bottomed, multiple-duct conduit units, do not excavate beyond indicated depths. Hand-excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.
 2. For pipes and equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90 degrees (bottom 1/4 of the circumference). Fill depressions with bedding or tamped cushion sand backfill. At each pipe joint, dig bell holes to relieve pipe bell of loads to ensure continuous bearing of pipe barrel on bearing surface.

3.9 FILLING, BACKFILLING, AND COMPACTION

- A. Do not place fill material on surfaces that are muddy, frozen, or contain frost or ice.
- B. Place soil stabilization geotextile below crushed stone where shown in drawings after subgrade has been approved and before placement of crushed stone material.
- C. Use structural fill to increase grades within building or tunnel areas, in trenches, as exterior backfill against walls with footing drains, and as exterior backfill where pavement or walkways abut building.

- D. Contractor may use flowable fill to increase grades and as interior backfill against foundations and in trenches. Allow fill to cure for at least 7 days before setting forms for concrete foundations.
- E. Use crushed stone around footing drains as detailed in drawings. Wrap drainage fill with filter fabric.
- G. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and are carried below bottom of such footings or pass under wall footings. Place concrete to level of bottom of adjacent footing.
- H. Backfill foundation excavations as soon as possible following construction of foundations and foundation walls.
- I. Backfill and fill against tunnel and foundation walls evenly on both sides to prevent displacement of construction. For walls with fill on one side only, do not backfill until concrete has achieved 70 percent of its design strength and walls have been braced.
- J. Begin filling in lowest section of area.
- K. Place fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- L. Lifts or portions thereof not compacted in accordance with specifications shall be recompacted or removed and replaced to meet compaction requirements.
- M. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density in accordance with ASTM D 1557, Modified Proctor:
 - 1. Under structures, footings, foundations, building slabs, and tunnel segments: Compact top 12 inches of subgrade and each layer of fill material to 95 percent.
 - 2. Under pavements: Compact top 12 inches of subgrade and each layer of fill material to 95 percent.
 - 3. Under walkways: Compact top 6 inches of subgrade and each layer of fill material to 95 percent.
 - 4. Under lawn or unpaved areas: Compact top 6 inches of subgrade and each layer of fill material to 90 percent.
 - 5. Cushion sand: Compact to 100 percent.
- N. Where a power roller is used for compaction, do not approach nearer than 10 feet from walls of new or existing construction.
- O. Moisture Control: Where subgrade or layer of soil material must be moisture- conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
 - 1. Remove and replace or scarify and air dry soil material too wet to permit compaction to specified density.

2. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to satisfactory value.

3.11 TOLERANCES

- A. Excavation for structures shall conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot except to facilitate drainage during construction stage.
- B. Surface of subbase under building slabs shall be graded smooth and even, free of voids, and rolled to required elevation. Provide final grades within tolerance of 1/2 inch when tested with 10-foot straightedge.

- - - - - END - - - - -

SECTION 31 23 19
DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

1.2 SUMMARY:

- A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
 - 1. Implementation of the Erosion and Sedimentation Control Plan.
 - 2. Dewater excavations, including seepage and precipitation.
- B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

1.3 REQUIREMENT:

- A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 300 mm (1 foot) below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.
- B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 300 mm (1 foot) below prevailing excavation surface.
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain stability of sides and bottom of excavation.
- E. Construction operations are performed in the dry.
- F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:
 - 1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase

and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.

2. Erosion is controlled.
 3. Flooding of excavations or damage to structures does not occur.
 4. Surface water drains away from excavations.
 5. Excavations are protected from becoming wet from surface water, or insure excavations are dry before additional work is undertaken.
- G. Permitting Requirements: The contractor shall comply with and obtain the required State and County permits where the work is performed.

1.4 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
- F. Excavation, backfilling, site grade and utilities: Section 31 20 00, EARTH MOVING.

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Drawings and Design Data:
 1. Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation.
 2. Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.
 3. Include a written report outlining control procedures to be adopted if dewatering problem arises.
 4. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.
- C. Inspection Reports.

D. All required permits.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.
- B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of 300 mm (1 foot) below prevailing excavation surface at all times.

3.2 OPERATION:

- A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.
- B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

3.3 WATER DISPOSAL:

- A. Dispose of water removed from the excavations in such a manner as:
 - 1. Will not endanger portions of work under construction or completed.
 - 2. Will cause no inconvenience to Government or to others working near site.
 - 3. Will comply with the stipulations of required permits for disposal of water.
 - 4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.
- B. Excavation Dewatering:

1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
 2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
 3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
 4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.
- C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

3.4 STANDBY EQUIPMENT:

Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain dewatering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

3.5 CORRECTIVE ACTION:

If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor, at no additional cost to Government.

3.6 DAMAGES:

Immediately repair damages to adjacent facilities caused by dewatering operations.

3.7 REMOVAL:

Insure compliance with all conditions of regulating permits and provide such information to the Resident Engineer. Obtain written approval from Resident Engineer before discontinuing operation of dewatering system.

----- E N D -----

**SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown. Construction shall include the following:
- B. Curb.
- C. Pedestrian Pavement: Walks, grade slabs, wheelchair curb ramps, steps.
- E. Equipment Pads:

1.2 RELATED WORK

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Section 31 20 00, EARTH MOVING.
- C. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 00, CAST-IN-PLACE-CONCRETE.
- D. Metal Components of Steps (Nosing and Railing): Section 05 50 00, METAL FABRICATIONS.

1.3 DESIGN REQUIREMENTS

Design all elements with the latest published version of applicable codes.

1.4 WEATHER LIMITATIONS

Placement of concrete shall be as specified under Article 3.8, COLD WEATHER and Article 3.7, HOT WEATHER of Section 03 30 00, CAST-IN-PLACE CONCRETE.

1.5 SELECT SUBBASE MATERIAL JOB-MIX

The Contractor shall retain and reimburse a testing laboratory to design a select subbase material mixture and submit a job-mix formula to the Resident Engineer, in writing, for approval. The formula shall include the source of materials, gradation, plasticity index, liquid limit, and laboratory compaction curves indicating maximum density at optimum moisture.

1.6 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
 - 1. Expansion joint filler

2. Hot poured sealing compound
 3. Reinforcement
 4. Curing materials
- C. Data and Test Reports: Select subbase material.
1. Job-mix formula.
 2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

1.7 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. Refer to the latest edition of all referenced Standards and codes.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- M031MM031-07-UL.....Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement (ASTM A615/A615M-09)
- M055MM055-09-UL.....Steel Welded Wire Reinforcement, Plain, for Concrete (ASTM A185)
- M147-65-UL.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)
- M148-05-UL.....Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309)
- M171-05-UL.....Sheet Materials for Curing Concrete (ASTM C171)
- M182-05-UL.....Burlap Cloth Made from Jute or Kenaf and Cotton Mats
- M213-01-UL.....Prefomed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type) (ASTM D1751)
- M233-86-UL.....Boiled Linseed Oil Mixer for Treatment of Portland Cement Concrete
- T099-09-UL.....Moisture-Density Relations of Soils Using a 2.5 kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop
- T180-09-UL.....Moisture-Density Relations of Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
- C. American Society for Testing and Materials (ASTM):
- C94/C94M-09.....Ready-Mixed Concrete
- C143/C143M-09.....Slump of Hydraulic Cement Concrete

PART 2 - PRODUCTS**2.1 GENERAL**

Concrete shall be Type C, air-entrained as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, with the following exceptions:

<u>TYPE</u>	<u>MAXIMUM SLUMP*</u>
Curb & Gutter	75 mm (3")
Pedestrian Pavement	75 mm (3")
Vehicular Pavement	50 mm (2") (Machine Finished) 100 mm (4") (Hand Finished)
Equipment Pad	75 to 100 mm (3" to 4")
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

2.2 REINFORCEMENT

- A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.
- B. Welded wire-fabric shall conform to AASHTO M55.
- C. Dowels shall be plain steel bars conforming to AASHTO M31. Tie bars shall be deformed steel bars conforming to AASHTO M31.

2.3 SELECT SUBBASE (WHERE REQUIRED)

- A. Subbase material shall consist of select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials conforming to AASHTO M147, Grading E or F.
- B. Materials meeting other gradations than that noted will be acceptable whenever the gradations are within a tolerance of three to five percent, plus or minus, of the single gradation established by the job-mix formula.
- C. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

2.4 FORMS

- A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.
- B. Do not use forms if they vary from a straight line more than 3 mm (1/8 inch) in any 3000 mm (ten foot) long section, in either a horizontal or vertical direction.

- C. Wood forms should be at least 50 mm (2 inches) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.5 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
 1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry.
 2. Impervious Sheeting conforming to AASHTO M171.

2.6 EXPANSION JOINT FILLERS

Material shall conform to AASHTO M213.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTH MOVING.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SELECT SUBBASE

- A. Mixing: Proportion the select subbase by weight or by volume in quantities so that the final approved job-mixed formula gradation, liquid limit, and plasticity index requirements will be met after subbase course has been placed and compacted. Add water in approved quantities, measured by weight or volume, in such a manner to produce a uniform blend.
- B. Placing:
 1. Place the mixed material on the prepared subgrade in a uniform layer to the required contour and grades, and to a loose depth not to exceed 200 mm (8 inches), and that when compacted, will produce a layer of the designated thickness.
 2. When the designated compacted thickness exceeds 150 mm (6 inches), place the material in layers of equal thickness. Remove unsatisfactory areas and replace with satisfactory mixture, or mix the material in the area.
 3. In no case will the addition of thin layers of material be added to the top layer in order to meet grade.
 4. If the elevation of the top layer is 13 mm (1/2 inch) or more below the grade, excavate the top layer and replace with new material to a depth of at least 75 mm (3 inches) in compacted thickness.
- C. Compaction:

1. Perform compaction with approved equipment (hand or mechanical) well suited to the material being compacted.
2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
3. Compact each layer to at least 95 percent or 100 percent of maximum density as determined by AASHTO T180 or AASHTO T99 respectively.

D. Smoothness Test and Thickness Control:

Test the completed subbase for grade and cross section with a straight edge.

1. The surface of each layer shall not show any deviations in excess of 10 mm (3/8 inch).
2. The completed thickness shall be within 13 mm (1/2 inch) of the thickness as shown.

E. Protection:

1. Maintain the finished subbase in a smooth and compacted condition until the concrete has been placed.
2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted subbase, excavate, and reconstruct it with new material meeting the requirements herein specified, at no additional cost to the VA.

3.3 SETTING FORMS

A. Base Support:

1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.

B. Form Setting:

1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
3. Forms shall conform to line and grade with an allowable tolerance of 3 mm (1/8 inch) when checked with a straightedge and shall not deviate from true line by more than 6 mm (1/4 inch) at any point.
4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
5. Clean and oil forms each time they are used.

C. The Contractor's Registered Professional Land Surveyor, specified in Section 00 72 00, GENERAL CONDITIONS, shall establish and control the alignment and the grade elevations of the forms or concrete slipforming machine operations.

1. Make necessary corrections to forms immediately before placing concrete.
2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

3.4 EQUIPMENT

- A. The Resident Engineer shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

3.5 PLACING REINFORCEMENT

- A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement.
- B. Before the concrete is placed, the Resident Engineer shall approve the reinforcement, which shall be accurately and securely fastened in place with suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown.

3.6 PLACING CONCRETE - GENERAL

- A. Obtain approval of the Resident Engineer before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the Resident Engineer before placing concrete.
- C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.
- E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.
- F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.

- G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

3.7 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

3.8 PLACING CONCRETE FOR VEHICULAR PAVEMENT

- A. Deposit concrete into the forms as close as possible to its final position.
- B. Place concrete rapidly and continuously between construction joints.
- C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.
- D. Finish the surface to the elevation and crown as shown.
- E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes without approval by the Resident Engineer.

3.9 CONCRETE FINISHING - GENERAL

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
 1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
 2. Maintain finishing equipment and tools in a clean and approved condition.

3.10 CONCRETE FINISHING CURB

- A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 6mm (1/4 inch) or as otherwise detailed.
- B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.
- C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.

- D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.
- E. Except at grade changes or curves, finished surfaces shall not vary more than 3 mm (1/8 inch) for gutter and 6 mm (1/4 inch) for top and face of curb, when tested with a 3000 mm (10 foot) straightedge.
- F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- G. Correct any depressions which will not drain.
- H. Visible surfaces and edges of finished curb shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.11 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. Walks, Grade Slabs, Wheelchair Curb Ramps:
 - 1. Finish the surfaces to grade and cross section with a metal float, trowled smooth and finished with a broom moistened with clear water.
 - 2. Brooming shall be transverse to the line of traffic.
 - 3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
 - 4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 2 mm (1/16 inch) in depth.
 - 5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
 - 6. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
 - 7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- B. Steps: The method of finishing the steps and the sidewalls is similar to above except as herein noted.
 - 1. Remove the riser forms one at a time, starting with the top riser.
 - 2. After removing the riser form, rub the face of the riser with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Use an outside edger to round the corner of the tread; use an inside edger to finish the corner at the bottom of the riser.

3. Give the risers and sidewall a final brush finish. The treads shall have a final finish with a stiff brush to provide a non-slip surface.
4. The texture of the completed steps shall present a neat and uniform appearance and shall not deviate from a straightedge test more than 5 mm (3/16 inch).

3.12 CONCRETE FINISHING FOR VEHICULAR PAVEMENT

- A. Accomplish longitudinal floating with a longitudinal float not less than 3000 mm (10 feet) long and 150 mm (6 inches) wide, properly stiffened to prevent flexing and warping. Operate the float from foot bridges in a sawing motion parallel to the direction in which the pavement is being laid from one side of the pavement to the other, and advancing not more than half the length of the float.
- B. After the longitudinal floating is completed, but while the concrete is still plastic, eliminate minor irregularities in the pavement surfaces by means of metal floats, 1500 mm (5 feet) in length, and straightedges, 3000 mm (10 feet) in length. Make the final finish with the straightedges, which shall be used to float the entire pavement surface.
- C. Test the surface for trueness with a 3000 mm (10 foot) straightedge held in successive positions parallel and at right angles to the direction in which the pavement is being laid and the entire area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one half the length of the straightedge. Correct all irregularities and refinish the surface.
- D. The finished surface of the pavement shall not vary more than 6 mm (1/4 inch) in both longitudinal and transverse directions when tested with a 3000 mm (10 foot) straightedge.
- E. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
- F. When most of the water glaze or sheen has disappeared and before the concrete becomes nonplastic, give the surface of the pavement a broomed finish with an approved fiber broom not less than 450 mm (18 inches) wide. Pull the broom gently over the surface of the pavement from edge to edge. Brooming shall be transverse to the line of traffic and so executed that the corrugations thus produced will be uniform in character and width, and not more than 3 mm (1/8 inch) in depth. Carefully finish the edge of the pavement along forms and at the joints with an edging tool. The brooming shall eliminate the flat surface left by the surface face of the edger.
- G. The finish surfaces of new and existing abutting pavements shall coincide at their juncture.

3.13 CONCRETE FINISHING EQUIPMENT PADS

- A. After the surface has been struck off and screeded to the proper elevation, give it a smooth dense float finish, free from depressions or irregularities.
- B. Carefully finish all slab edges with an edger having a radius as shown in the Drawings.
- C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary more than 3 mm (1/8 inch) when tested with a 3000 mm (10 foot) straightedge.
- D. Correct irregularities exceeding the above.

3.14 JOINTS - GENERAL

- A. Place joints, where shown, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.
- B. Joints shall be straight and continuous from edge to edge of the pavement.

3.15 CONTRACTION JOINTS

- A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown or by sawing with a blade producing the required width and depth.
- B. Construct joints in curbs by inserting 3 mm (1/8 inch) steel plates conforming to the cross sections of the curb.
- C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.
- D. Finish edges of all joints with an edging tool having the radius as shown.
- E. Score pedestrian pavement with a standard grooving tool or jointer.

3.16 EXPANSION JOINTS

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
 - 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.

2. Using joint filler of the type, thickness, and width as shown.
3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.17 CONSTRUCTION JOINTS

- A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as shown.
- B. Place transverse construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.
- C. Use a butt-type joint with dowels in curb if the joint occurs at the location of a planned joint.
- D. Use keyed joints with tiebars if the joint occurs in the middle third of the normal curb joint interval.

3.18 FORM REMOVAL

- A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.
- B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.20 CURING OF CONCRETE

- A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the Resident Engineer.
- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).
- C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 0.1 mm (4 mils) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 300 mm (12 inches). Securely anchor sheeting.
- D. Liquid Membrane Curing:

1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 5 m²/L (200 square feet per gallon) for both coats.
2. Do not allow the concrete to dry before the application of the membrane.
3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

3.21 CLEANING

- A. After completion of the curing period:
 1. Remove the curing material (other than liquid membrane).
 2. Sweep the concrete clean.
 3. After removal of all foreign matter from the joints, seal joints as herein specified.
 4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.22 PROTECTION

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the Resident Engineer, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the Resident Engineer.

3.23 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

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SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.2 RELATED WORK

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 00, EARTH MOVING.
- C. Pavement Markings: Section 32 17 23, PAVEMENT MARKINGS.

1.3 INSPECTION OF PLANT AND EQUIPMENT

The Resident Engineer shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

1.4 ALIGNMENT AND GRADE CONTROL

The Contractor's Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Data and Test Reports:
 - 1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
 - 2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.
 - 3. Job-mix formula.
- C. Certifications:

1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
 2. Asphalt cement certificate of conformance to State Highway Department requirements.
 3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification.
- D. One copy of State Highway Department Specifications.
- E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

PART 2 - PRODUCTS

2.1 GENERAL

Crushed stone base shall be type 4 and conform to the requirements of section 304 of the state specifications.

Gradation shall conform to the following:

Gradation shall conform to the following:

Sieve Size Designation	Percent Passing by Weight
3 inch	100
2 inch	90-100
1/4 inch	30-65
No. 40	5-40
No. 200	0-10

Surface course: type 7F, NYSDOT sections 401, 403. See section 1.3 c of these specifications for other requirements.

Binder course: type 3, NYSDOT sections 401, 403. See section 1.3 c of these specifications for other requirements.

Tack coat: NYSDOT 702-90

General: asphalt concrete and all related items shall meet the requirements of NYSDOT section 400.

PART 3 - EXECUTION

3.1 GENERAL

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

- A. Provide hot plant-mixed asphaltic concrete paving materials.
1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.
 2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

3.3 SUBGRADE

- A. Shape to line and grade and compact with self-propelled rollers.

- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Resident Engineer or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

- A. Subbase (when required)
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.
- B. Base
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).
- E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING

- A. Remove all loose materials from the compacted base.
- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the COTR.
- C. Receipt of asphaltic concrete materials:
 - 1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C(280 degrees F).

2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.

D. Spreading:

1. Spread material in a manner that requires the least handling.
2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
 - a. No depressions which will retain standing water.
 - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.6 APPLICATION OF SEAL COAT

- A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer's recommendations as approved by the COTR.
- B. Apply one coat of the specified sealer.
- C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

3.7 PROTECTION

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.8 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

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**SECTION 32 17 23
PAVEMENT MARKINGS**

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall consist of furnishing and applying paint on pavement surfaces, in the form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings, in accordance with the details as shown or as prescribed by the Resident Engineer. Conform to the Manual on Uniform Traffic Control Devices for Streets and Highways, published by the U.S. Department of Transportation, Federal Highway Administration, for details not shown.

1.2 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish Manufacturer's Certificates and Data certifying that the following materials conform to the requirements specified.

B. Paint.

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.):

TT-P-1952D.....Paint, Traffic Black, and Airfield Marking,
Waterborne

C. Master Painters Institute (MPI):

Approved Product List - 2010

PART 2 - PRODUCTS

2.1 PAINT

Paint for marking pavement (parking lot and zone marking) shall conform to MPI No. 97, color as shown. Paint for obliterating existing markings shall conform to Fed. Spec. TT-P-1952D. Paint shall be in containers of at least 18 L (5 gallons). A certificate shall accompany each batch of paint stating compliance with the applicable publication.

2.3 PAINT APPLICATOR

Apply all marking by approved mechanical equipment. The equipment shall provide constant agitation of paint and travel at controlled speeds. Synchronize one or more paint "guns" to automatically begin and cut off paint flow in the case of skip lines. The equipment shall have manual control to apply continuous lines of varying length and marking widths as shown. Provide pneumatic spray guns for hand application of paint in

areas where a mobile paint applicator cannot be used. If the equipment does not have a glass bead dispenser, use a separate piece of equipment.

Adjust and synchronize the equipment with the paint applicator so that the reflective beads are distributed uniformly on the paint lines within ten seconds without any waste. An experienced technician that is thoroughly familiar with equipment, materials, and marking layouts shall control all painting equipment and operations.

2.4 SANDBLASTING EQUIPMENT

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall furnish not less than 0.08 m³/s (150 cfm) of air at a pressure of not less than 625 kPa (90 psi) at each nozzle used.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by the Resident Engineer. The application of paint conforming to Fed. Spec. TT-P-1952D is an option to removal of existing paint markings on asphalt pavement. Apply the black paint in as many coats as necessary to completely obliterate the existing markings. Where oil or grease are present on old pavements to be marked, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint. Pavement marking shall follow as closely as practicable after the surface has been cleaned and dried, but do not begin any marking until the Resident Engineer has inspected the surface and gives permission to proceed. The Contractor shall establish control points for marking and provide templates to control paint application by type and color at necessary intervals. The Contractor is responsible to preserve and apply marking in conformance with the established control points.

3.2 APPLICATION

Apply uniformly painted pavement marking of required color(s), length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces in conformance with the details as shown and established control points. The length and width of lines shall conform within a tolerance of plus or minus 75 mm (3 inches) and plus or minus 3 mm (1/8 inch), respectively, in the case of skip markings. The length of intervals shall not exceed the line length tolerance. Temperature of the surface to be painted and the atmosphere shall be above 10°C (50°F) and less than 35°C (95°F). Apply the paint at a wet film thickness of 0.4 mm (0.015 inch). Apply paint in one coat. At the direction of the Resident Engineer, markings showing light spots may receive additional coats. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the marking, discontinue paint operations until cause of the slow drying is determined and corrected. Remove and replace marking that is applied at less than minimum material rates; deviates from true alignment; exceeds stipulated length and width tolerances; or shows light spots, smears, or other deficiencies or irregularities. Use carefully controlled sand blasting, approved grinding equipment, or other approved method to remove marking so that the surface to which the marking was applied will not be damaged.

3.3 PROTECTION

Conduct operations in such a manner that necessary traffic can move without hindrance. Protect the newly painted markings so that, insofar as possible, the tires of passing vehicles will not pick up paint. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic. Efface and replace damaged portions of markings at no additional cost to the Government.

3.4 DETAIL PAVEMENT MARKING

Use Detail Pavement Markings, exclusive of actual traffic lane marking, at exit and entrance islands and turnouts, on curbs, at crosswalks, at parking bays, and at such other locations as shown. Show the International Handicapped Symbol at indicated parking spaces. Color shall be as shown. Apply paint for the symbol using a suitable template

that will provide a pavement marking with true, sharp edges and ends.
Place detail pavement markings of the color(s), width(s) and length(s),
and design pattern at the locations shown.

3.6 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

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SECTION 33 10 00
WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION:

Underground water distribution system complete, ready for operation, including all appurtenant structures, and connections to both new building service lines and to existing water supply.

1.2 RELATED WORK:

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing: Section 31 20 00, EARTH MOVING.
- C. Concrete: Section 03 30 00, CAST-IN-PLACE CONCRETE.

1.3 DEFINITIONS:

- A. Water Distribution: Pipelines and appurtenances which are part of the distribution system. The distribution system comprises the network of piping located throughout building areas and other areas of water use, including hydrants, valves, and other appurtenances used to supply water for domestic and fire-fighting/fire protection purposes.
- B. Water Service Line: Pipe line connecting building piping to water distribution lines.

1.4 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be product of one manufacturer.
 - 2. Nameplate: Nameplate bearing manufacturer's name or identifiable trademark 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.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Water lines and the extension, and/or modifications to Public Utility systems.
- C. Comply with all rules and regulations of Federal, State, and Local Health Departments having jurisdiction over the design, construction, and operation of potable water systems.
- D. All material surfaces in contact with potable water shall comply with NSF 61.

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data (Submit all items as one package):
(Ductile Iron Pipe and Polyvinyl Chloride (PVC) shall be in accordance with AWWA C600 and C605 respectively; and shall be provided to Resident Engineer for approval.)
 - 1. Piping.
 - 2. Gaskets.
 - 3. Valves.
 - 4. Fire hydrants.
 - 5. Street washer.
 - 6. Meter.
 - 7. Vaults, frames and covers.
 - 8. Steps.
 - 9. Post indicator.
 - 10. Valve boxes.
 - 11. Corporation and curb stops.
 - 12. Curb stop boxes.
 - 13. Joint restraint.
 - 14. Disinfection products.
 - 15. Link/sleeve seals.
- C. Testing Certifications:
 - 1. Hydrostatic Testing.
 - 2. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.

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 National Standards Institute (ANSI/ASME):
 - B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings
 - B16.18.....Cast Bronze Solder Joint Pressure Fittings
 - B16.26-88.....Cast Copper Alloy Fittings for Flared Copper
Tubes
 - B40.100-98.....Pressure Gauges and Gauge Attachments
- C. American Society for Testing and Materials (ASTM):
 - A123-97.....Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
 - A148M-03.....Standard Specifications for Steel Castings

A242-00.....	Standard Specifications for High Strength Low Alloy Structural Steel AASHTO No. M161
A307-02.....	Standard Specifications for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A536-04.....	Standard Specifications for Ductile Iron Castings
B61-02.....	Steam or Valve Bronze Castings
B62-02.....	Composition Bronze or Ounce Metal Castings
B88-02.....	Seamless Copper Water Tube
B828.....	Standard Practice: Soldering and Brazing Copper Tube and fittings
C32-04.....	Sewer and Manhole Brick (Made from Clay or Shale)
C139-03.....	Concrete Masonry Units for Construction of Catch Basins and Manholes
D1784-03.....	Standard Specifications for Rigid PVC Compounds and CPVC Compounds
D1869-00.....	Standard Specifications for Rubber Rings for Asbestos Cement Pipe
D2464-99.....	Standard Specifications for Threaded PVC Pipe Fittings, Schedule 80
D2467-02.....	Standard Specifications for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
D3139-98.....	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
F477-02e1.....	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
C32-04.....	Standard Specifications for Sewer Manhole Brick
D. American Water Works Association (AWWA):	
B300-04.....	Hypochlorites
B301-04.....	Liquid Chlorine
C104-04.....	Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
C105-99.....	Polyethylene Encasement for Gray and Ductile C.I. Piping for Water and Other Liquids
C110-03.....	Ductile-Iron and Gray-Iron Fittings, 80 mm (3 Inches) Through 1200 mm (48 Inches) for Water and Other Liquids
C111-01.....	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

- C115-99.....Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
- C150-02.....American National Standard for Thickness Design of Ductile Iron Pipe
- C151-96.....Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
- C153-00.....Ductile-Iron Compact Fittings, 80 mm (3 inches) Through 300 mm (12 Inches) for Water and Other Liquids
- C500-02.....Gate Valves for Water and Sewerage Systems
- C502a-95.....Dry-Barrel Fire Hydrants
- C503-97.....Wet-Barrel Fire Hydrants
- C508-01.....Swing Check Valves for Waterworks Service, 2 Inches (50 mm) Through 24 Inches (600mm) NPS
- C509-01.....Resilient Seated Gate Valve for Water and Sewage System
- C510-97.....Double Check Valve Back-Flow Prevention Assembly
- C511-97.....Reduced Pressure Principle Back-Flow Prevention Assembly
- C550-01.....Protective Epoxy Interior Coatings for Valves and Hydrants
- C600-01.....Installation for Ductile-Iron Water Mains and Their Appurtenances
- C605-94.....Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
- C651-92.....Disinfecting Water Mains
- C800-01.....Underground Service Line Valves and Fittings
- C900-97.....Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Thru 12 Inches, for Water
- C905-97.....Polyvinyl Chloride (PVC) Pressure Pipe 14 Inches Thru 36 Inches
- E. National Fire Protection Association (NFPA):
- 24-95.....Installation of Private Fire Service Mains and Their Appurtenances
- 291-01.....Fire Flow Testing and Marking of Hydrants
- 1141-98.....Fire Protection in Planned Building Groups
- F. NSF International:
- 14-03.....Plastics Piping Components and Related Materials
- 61-02.....Drinking Water System Components-Health Effects (Sections 1-9)

- G. American Welding Society (AWS):
A5.8-04.....Braze Filler Metal
- H. Foundation for Cross-Connection Control and Hydraulic Research-2005
- I. Copper Development Association's Copper Tube Handbook-2005

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS:

- A. Ductile iron pipe, direct buried:
 1. Provide ductile iron pipe conforming to the requirements of AWWA C151, Pressure Class 350 for Pipe 100 mm through 300 mm (4 inches through 12 inches) in diameter with standard thickness cement mortar lining interior, and interior asphaltic seal coat and exterior asphaltic coating, in accordance with AWWA and ANSI Standards.
 2. Below Grade: Supply pipe in lengths not in excess of a nominal 6 m (20 feet) with rubber ring type push-on joints, mechanical joint or approved restrained joint. Provide flange joint pipe where shown on the drawings. Provide mechanical and restrained joint pipe with sufficient quantities of accessories as required for each joint.
- B. Omitted
- C. All Pipe Fittings: Ductile iron with a minimum pressure rating of 2400 kPa (350 psi). Fittings shall meet the requirements of ANSI and AWWA specifications as applicable. Rubber gasket joints shall conform to AWWA C111 for mechanical and push-on type joints. Ball joints shall conform to AWWA C151 with a separately cast ductile iron bell conforming to ASTM A148. Flanged fittings shall conform to AWWA C115 and be furnished flat faced and drilled to 850 kPa (125 psi) or 1725 kPa (250 psi) template in accordance with ANSI B16.1 with full faced gaskets.
- D. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior.
- E. Provide a factory hydrostatic test of not less than 3.5 MPa (500 psi) for all pipe in accordance with AWWA C151.
- F. Provide non-detectable adhesive backed identification tape on top and sides of all buried ductile iron pipe, extended from joint to joint along the length of the pipe and have black lettering identifying the pipe service at no more than 300 mm (12 inch) intervals. According to service, the tape background color shall be as follows: force main/sanitary-green; potable water-blue.

2.2 POLYVINYL CHLORIDE PIPE AND FITTINGS:

- A. Class-Rated Polyvinyl Chloride (PVC) Pipe:

1. PVC pipe and accessories 100 mm to 356 mm (4 inches-14 inches) in diameter, AWWA C900 "Polyvinyl Chloride (PVC) Pressure Pipe", Class 200, DR 14, cast iron outside diameters, unless otherwise shown or specified.
2. PVC pipe and accessories 400 mm (16 inches) or larger, AWWA C905, "Polyvinyl Chloride Water Transmission Pipe", Class 235, DR 18, cast iron outside diameters unless otherwise shown or specified. Pipe and accessories shall bear the NSF mark indicating pipe size, manufacturer's name, AWWA and/or ASTM Specification number, working pressure and production code. Pipe and couplings shall be made in accordance with ASTM D1784.
3. PVC Pipe and Accessories Smaller than 100 mm (4 inches): Schedule 80, meeting the requirements of ASTM D-1785, Type 1, Grade 1. All exposed piping shall be CPVC meeting requirements of ASTM F441.

B. Joints:

1. Pipe 75 mm (3 inches) and Greater in Diameter: Push-on type with factory installed solid cross section elastomeric ring meeting the requirements of ASTM F-477.
2. Pipe Less Than 75 mm (3 inches) in Diameter: Threaded (ASTM D-2464) or solvent welded (ASTM 2467). Use Teflon tape or liquid Teflon thread lubricant approved for use on plastic on all threaded joints.

C. Fittings:

1. Class-Rated Pipe 75 mm (3 inches) in Diameter and Greater: Ductile iron with mechanical joints conforming to the requirements of AWWA C153.
2. For Schedule 80 Pipe less than 75 mm (3 inches) in Diameter: Threaded or solvent weld. Threaded PVC fittings shall conform to ASTM D2464. CPVC fittings shall conform to ASTM F437 for threaded fittings and ASTM F439 for solvent weld fittings.

2.3 POTABLE WATER:

Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.4 DISINFECTION CHLORINE:

- A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.
- B. Sodium hypochlorite shall conform to AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5.g tablets, and shall contain 65 percent chlorine by weight.

2.5 WARNING TAPE

Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape, detectable type, blue with black letters, and imprinted with "CAUTION BURIED WATER LINE BELOW".

PART 3 - EXECUTION**3.1 BUILDING SERVICE LINES:**

Install water service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed provide temporary caps.

3.2 REGRADING:

Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.

3.3 PIPE LAYING, GENERAL:

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the Resident Engineer.
- B. All pipe and fittings shall be subjected to a careful inspection just prior to being laid or installed. If any defective piping is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional expense to the Government. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when installed or laid, shall conform to the lines and grades required.
- C. All buried piping shall be installed to the lines and grades as shown on the drawings. All underground piping shall slope uniformly between joints where elevations are shown.
- D. Contractor shall exercise extreme care when installing piping to shore up and protect from damage all existing underground water line and power lines, and all existing structures.
- E. Do not lay pipe on unstable material, in wet trench, or when trench or weather conditions are unsuitable.
- F. Do not lay pipe in same trench with other pipes or utilities unless shown otherwise on drawings.
- G. Hold pipe securely in place while joint is being made.
- H. Do not walk on pipes in trenches until covered by layers of earth well tamped in place to a depth of 300 mm (12 inches) over pipe.

- I. Full length of each section of pipe shall rest solidly upon pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipes on wood blocking.
- J. Tees, plugs, caps, bends and hydrants on pipe installed underground shall be anchored. See section 3.7 "PIPE SUPPORTS".
- K. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water and chemical, or mechanical injury. At completion of all work, thoroughly clean exposed materials and equipment.
- L. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the manufacturer.
- M. Warning tape shall be continuously placed 300 mm (12 inches) above buried water pipes.

3.4 DUCTILE IRON PIPE:

- A. Installing Pipe: Lay pipe in accordance with AWWA C600 with polyethylene encasement if required in accordance with AWWA C105. Provide a firm even bearing throughout the length of the pipe by tamping selected material at the sides of the pipe up to the spring line.
- B. All pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Cement lining shall be undamaged.
- D. Jointing Ductile-Iron Pipe:
 - 1. Push-on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe is to be aligned with the bell of the pipe to which it is joined, and pushed home with approved means.
 - 2. Mechanical Joints at Valves, Fittings: Install in strict accordance with AWWA C111. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gaskets with soapy water before tightening the bolts. Bolts shall be tightened to the specified torque.
 - 3. Ball Joints: Install in strict accordance with the manufacturer's instructions. Where ball joint assemblies occur at the face of structures, the socket end shall be at the structure and ball end assembled to the socket.

4. Flanged joints shall be in accordance with AWWA C115. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

3.5 PVC PIPE:

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA 605. Place selected material and thoroughly compacted to one foot above the top of the pipe and thereafter back filled as specified in Section 31 20 00, EARTH MOVING.
- B. Copper Tracer Wire: Copper tracer wire consisting of No. 14 AWG solid, single conductor, insulated copper wire shall be installed in the trench with all piping to permit location of the pipe with electronic detectors. The wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be made by stripping the insulation from the wire and soldering with rosin core solder. Solder joints shall be wrapped with rubber tape and electrical tape. At least every 300 m (1000 feet), provide a 2.3 kg (5 pound) magnesium anode attached to the main tracer wire by solder. The solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall be attached at the end of each line.
- C. Magnetic markers may be used in lieu of copper tracer wire to aid in future pipe locating. Generally, install markers on 6 m (20 foot) centers. If pipe is in a congested piping area, install on 3 m (10 foot) centers. Prepare as-built drawing indicating exact location of magnetic markers.

3.6 COPPER PIPE:

OMITTED

3.7 PIPE SUPPORTS:

- A. Supports:
 1. All piping shall be properly and adequately supported. Hangers, supports, base elbows and tees, and concrete piers and pads shall be provided as indicated on the drawings. If the method of support is not indicated on the drawings, exposed piping shall be supported by hangers wherever the structure is suitable and adequate to carry the superimposed load. Supports shall be placed approximately 2.4 m (8 feet) on centers and at each fitting.
 2. Hangers shall be heavy malleable iron of the adjustable swivel type, split ring type, or the adjustable-swivel, pipe-roll type for horizontal piping and adjustable, wrought iron, clamp type for vertical piping. Flat steel strap or chain hangers are not acceptable unless indicated on the drawings.

3. Hangers shall be attached to the structure, where possible, by beam clamps and approved concrete inserts set in the forms before concrete is poured. Where this method is impractical, anchor bolts with expanding lead shields, rawl drives, or malleable iron expansion shields will be permitted.
4. Where hangers cannot be used, the Contractor shall provide pipe saddle supports with pipe column and floor flange.

3.8 RESTRAINED JOINTS:

- A. Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained "locked-type" joints and the joints shall be capable of holding against withdrawal for line pressures 50 percent above the normal working pressure but not less than 1375 kPa (200 psi). The pipe and fittings shall be restrained push-on joints or restrained mechanical joints.
- B. The minimum number of restrained joints required for resisting force at fittings and changes in direction of pipe shall be determined from the length of retained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. Restrained pipe length shall be as shown on the drawings.
- C. Restrained joint assemblies with ductile iron mechanical joint pipe shall be "Flex-Ring", "Lok-Ring", or mechanical joint coupled as manufactured by American Cast Iron Pipe Company, "Mega-Lug" or approved equal.
- D. Ductile iron pipe bell and spigot joints shall be restrained with EBBA Iron Sales, Inc. Series 800 Coverall or approved equal.
- E. Ductile iron mechanical joint fittings shall be restrained with EBBA Iron Sales, Inc. Series 1200 Restrainer. The restraining device shall be designed to fit standard mechanical joint bells with standard T head bolts conforming to AWWA C111 and AWWA C153. Glands shall be manufactured of ductile iron conforming to ASTM A536. Set screws shall be hardened ductile iron and require the same torque in all sizes. Steel set screws not permitted. These devices shall have the stated pressure rating with a minimum safety factor of 2:1. Glands shall be listed with Underwriters Laboratories and/or approved by Factory Mutual.
- F. Thrust blocks shall not be permitted.
- G. Where ductile iron pipe manufactured with restrained joints is utilized, all restrained joints shall be fully extended and engaged prior to back filling the trench and pressurizing the pipe.
- H. PVC pipe bell and spigot joints shall be restrained with the Uni-Flange Corp. Series 1350 Restrainer or approved equal. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron

meeting ASTM A536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.

- I. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained with UNI-Flange Corp. Series 1300 Restrainer, EBBA Iron, Inc, Series 2000PV Mechanical Joint Restrainer Gland, or approved equal. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A-536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.

3.9 PIPE SEPARATION:

A. Horizontal Separation-Water Mains and Sewers:

1. Water mains shall be located at least 3 m (10 feet) horizontally from any proposed drain, storm sewer, sanitary or sewer service connection.
2. Water mains may be located closer than 3 m (10 feet) to a sewer line when:
 - a. Local conditions prevent a lateral separation of 3 m (10 feet); and
 - b. The water main invert is at least 450 mm (18 inches) above the crown of the sewer; and
 - c. The water main is either in a separate trench or in the same trench on an undisturbed earth shelf located one side of the sewer.
3. When it is impossible to meet (1) or (2) above, both the water main and drain or sewer shall be constructed of mechanical joint ductile iron pipe. Ductile iron pipe shall comply with the requirements listed in this specification section. The drain or sewer shall be pressure tested to the maximum expected surcharge head before back filling.

B. Vertical Separation-Water Mains and Sewers:

1. A water main shall be separated from a sewer so that its invert is a minimum of 450 mm (18 inches) above the crown of the drain or sewer whenever water mains cross storm sewers, sanitary sewers or sewer service connections. The vertical separation shall be maintained for that portion of the water main located within 10 feet horizontally of any sewer or drain crossed. A length of water main pipe shall be centered over the sewer to be crossed with joints equidistant from the sewer or drain.

2. Both the water main and sewer shall be constructed of slip-on or mechanical joint ductile iron pipe or PVC pipe equivalent to water main standards of construction when:
 - a. It is impossible to obtain the proper vertical separations described in (1) above; or
 - b. The water main passes under a sewer or drain.
3. A vertical separation of 450 mm (18 inches) between the invert of the sewer or drain and the crown of the water main shall be maintained where a water main crosses under a sewer. Support the sewer or drain lines to prevent settling and breaking the water main.
4. Construction shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer or drain line is at least 3 m (10 feet).

3.10 SETTING OF VALVES AND BOXES:

- A. Provide a surface concrete pad 450 by 450 by 150 mm (18 by 18 by 6 inches) to protect valve box when valve is not located below pavement.
- B. Clean valve and curb stops interior before installation.
- C. Set valve and curb stop box cover flush with finished grade.
- D. Valves shall be installed plumb and level and in accordance with manufacturer's recommendations.

3.11 SETTING OF FIRE HYDRANTS:

- A. Set center of each hydrant not less than 600 mm (2 feet) nor more than 1800 mm (6 feet) back of edge of road or face of curb. Fire apparatus connection shall face road with center of nozzle 450 mm (18 inches) above finished grade. Set barrel flange not more than 50 mm (2 inches) above finished grade.
- B. Set each hydrant on a slab of stone or concrete not less than 100 mm (4 inches) thick and 375 mm (15 inches) square. The service line to the hydrant, between the tee and the shoe of the hydrant, shall be fully restrained.
- C. Set bases in not less than 0.4 cubic meter (1/2 cubic yard) of crushed rock or gravel placed entirely below hydrant drainage device.
- D. Clean interiors of hydrants of all foreign matter before installation.

3.12 PIPE SLEEVES:

Install where water lines pass through retaining walls, building foundations and floors. Seal with modular mechanical type link seal. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.

3.13 FLUSHING AND DISINFECTING:

- A. Flush and disinfect new water lines in accordance with AWWA C651.

- B. Initial flushing shall obtain a minimum velocity in the main of 0.75 m/sec (2.5 feet per second) at 40 PSI residual pressure in water main. The duration of the flushing shall be adequate to remove all particles from the line.

Pipe Diameter		Flow Required to Produce 2.5 ft/sec (approx.) Velocity in Main		Number of Hydrant Outlets			
				Size of Tap. in. (mm)			
In	(mm)	gpm	(L/sec)	1(25)	1/2(38)	2(51)	2 1/2-in (64 mm)
				Number of taps on pipe			
4	(100)	100	(6.3)	1	--	--	1
6	(150)	200	(12.6)	--	1	--	1
8	(200)	400	(25.2)	--	2	1	1
10	(250)	600	(37.9)	--	3	2	1
12	(300)	900	(56.8)	--	--	3	2
16	(400)	1,600	(100.9)	--	--	4	2

The backflow preventers shall not be in place during the flushing.

- C. The Contractor shall be responsible to provide the water source for filling, flushing, and disinfecting the lines. Only potable water shall be used, and the Contractor shall provide all required temporary pumps, storage facilities required to complete the specified flushing, and disinfection operations.
- D. The Contractor shall be responsible for the disposal of all water used to flush and disinfect the system in accordance with all governing rules and regulations. The discharge water shall not be allowed to create a nuisance for activities occurring on or adjacent to the site.
- E. The bacteriological test specified in AWWA C651 shall be performed by a laboratory approved by the County Health Department. The cost of sampling, transportation, and testing shall be the responsibility of the Contractor.
- F. Re-disinfection and bacteriological testing of failed sections of the system shall be the sole responsibility of the Contractor.
- G. Before backflow preventers are installed, all upstream piping shall be thoroughly flushed.

3.14 HYDROSTATIC TESTING:

- A. Hydrostatic testing of the system shall occur prior to disinfecting the system.
- B. After new system is installed, except for connections to existing system and building, backfill at least 300 mm (12 inches) above pipe barrel, leaving joints exposed. The depth of the backfill shall be adequate to prevent the horizontal and vertical movement of the pipe during testing.

- C. Prior to pressurizing the line, all joint restraints shall be completely installed and inspected.
- D. If the system is tested in sections, and at the temporary caps at connections to the existing system and buildings, the Contractor shall provide and install all required temporary thrust restraints required to safely conduct the test.
- E. The Contractor shall install corporation stops in the line as required to purge the air out of the system. At the completion of the test, all corporation stops shall be capped.
- F. The Contractor shall perform pressure and leakage tests for the new system for 2 hours to 1375 kPa (200 psi). Leakage shall not exceed the following requirements.
 - 1. Copper Tubing: No leaks.
 - 2. Ductile Iron Pipe: AWWA C600. Provide to Resident Engineer office.
 - 3. Polyvinyl Chloride (PVC) AWWA C605. Provide to Resident Engineer office.

- - - E N D - - -

SECTION 33 30 00
SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION:

Outside, underground sanitary sewer system, complete, ready for operation, including all gravity flow lines manholes, cleanouts, frames, covers, structures, appurtenances, and connections to new building and structure, service lines, existing sanitary sewer lines, and existing sanitary structures, and all other incidentals.

1.2 RELATED WORK:

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING. Dewatering: Section 31 23 19, DEWATERING.
- C. Concrete Work Reinforcing, Placement and Finishing; Section 03 30 00, CAST-IN-PLACE CONCRETE.
- D. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.
- E. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, including model number, securely affixed in a conspicuous place on equipment, or name or trademark, including model number cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturers' Literature and Data: Submit the following as one package:
 - 1. Pipe, Fittings, and, Appurtenances.
 - 2. Jointing Material.
 - 3. Manhole and Structure Material.

- 4. Frames and Covers.
- 5. Steps and Ladders.
- 10. Acid Neutralization Tanks.

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):
 - A48/A48M-03.....Gray Iron Castings
 - A536-84(2004).....Ductile Iron Castings
 - A615/A615M-06.....Deformed and Plain Carbon-Steel Bars for
Concrete Reinforcement
 - A625/A625M-03.....Tin Mill Products, Black Plate, Single Reduced
 - A746-03.....Ductile Iron Gravity Sewer Pipe
 - C12-06.....Installing Vitrified Clay Pipe Lines
 - C76-05b/C76M-05b.....Reinforced Concrete Culvert, Storm Drain and
Sewer Pipe
 - C139-05.....Concrete Masonry Units for Construction of Catch
Basins and Manholes
 - C150-05.....Portland Cement
 - C425-04.....Compression Joints for Vitrified Clay Pipe and
Fittings
 - C478-06a/C478M-06a.....Precast Reinforced Concrete Manhole Sections
 - C700-05.....Vitrified Clay Pipe, Extra Strength, Standard
Strength, and Perforated
 - C828-03.....Low-Pressure Air Test of Vitrified Clay Pipe
Lines
 - C857-95(2001).....Minimum Structural Design Loading for
Underground Precast Concrete Utility Structures
 - D698-00a_{e1}.....Laboratory Compaction Characteristics of Soil
Using Standard Effort (12,400 ft-lbf/ft³ (600
kN-m/m³))
 - D2321-05.....Underground Installation of Thermoplastic Pipes
for Sewers and Other Gravity-Flow Applications
 - D2412-02.....Determination of External Loading
Characteristics of Plastic Pipe by Parallel-
Plate Loading
 - D2992-01.....Practice for Obtaining Hydrostatic or Pressure
Design Basis for Fiberglass (Glass-Fiber-
Reinforced Thermosetting-Resin) Pipe and
Fittings

- D3034-04a.....Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- D3212-96a (2003) e1.....Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- D3261-03.....Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
- D3350-05.....Polyethylene Plastics Pipe and Fittings Materials
- D4101-05a.....Polypropylene Injection and Extrusion Materials
- F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F679-06.....Poly (vinyl chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- F714-05.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- F794-03.....Poly (Vinyl Chloride)(PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
- F894-05.....Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
- F949-03.....Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings
- C. American Water Works Association (AWWA):
- C105/A21.5-05.....Polyethylene Encasement for Ductile Iron Pipe Systems
- C110/A21.10-03.....Ductile-Iron and Gray-Iron Fittings for Water
- C111/A21.11-00.....Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
- C115-99.....Flanged Ductile-Iron Pipe with Threaded Flanges
- C116-03.....Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron Pipe and Gray Iron Fittings for Water Supply Service
- C151-/A21.51-02 Ductile-Iron Pipe, Centrifugally Cast for Water
- C153-00 Ductile-Iron Compact Fittings for Water Services
- C508-01.....Swing Check Valves for Waterworks, 2 inches (50 mm) Through 24 inches (600 mm) NPS
- C509-01.....Resilient Seated Gate Valves for Water-Supply Service

- C515-01.....Reduced-Wall, Resilient-Seated Gate Valves For
Water Supply Service
- C512-04.....Air Release, Air/Vacuum, and Combination Air
Valves for Waterworks Service
- C550-05.....Protective Epoxy Interior Coatings for Valves
and Hydrants
- C600-05.....Installation for Ductile-Iron Water Mains and
Their Appurtenances
- C605-94.....Underground Installation of Polyvinyl (PVC)
Pressure Pipe and Fittings for Water
- C900-97Polyvinyl Chloride (PVC) Pressure Pipe, 100 mm
(4 inches) Through 300 mm (12 inches) for Water
Distribution
- C905-97.....Polyvinyl Chloride (PVC) Pressure Pipe and
Fabricated Fittings, 350 mm through 1,200 mm (14
Inches through 48 Inches), for Water
Transmission and Distribution
- C906-99.....Polyethylene (PE) Pressure Pipes and Fittings,
100 mm through 1575 mm (4 Inches through 63
Inches), for Water Distribution
- D. American Association of State Highway and Transportation Officials
(AASHTO):
- M198-05.....Joints for Concrete Pipe, Manholes, and Precast
Box Sections using Preformed Flexible Joint
Sealants
- E. Uni-Bell PVC Pipe Association:
- Uni-B-6-98.....Recommended Practice Low Pressure Air Testing of
Installed Sewer Pipe

PART 2 - PRODUCTS

2.1 PIPING:

- A. Gravity Flow Lines (Pipe and Fittings):
2. Polyvinyl Chloride (PVC):
- a. Pipe and Fittings, 100 to 375 mm (4 to 15 inches) in diameter,
shall conform to ASTM D3034, Type PSM, SDR 26. Pipe and fittings
shall have elastomeric gasket joints providing a watertight seal
when tested in accordance with ASTM D3212. Gaskets shall conform
to ASTM F477. Solvent welded joints shall not be permitted.
- 3) Solid wall pipe and fittings shall conform to ASTM F679, SDR 26
pipe and fittings shall gaskets conforming to ASTM F477, and

shall be able to withstand a hydrostatic pressure of 345 kPa (50 psi).

- B. Ductile Iron Pipe (DIP) for Sanitary Sewer: Shall conform to ASTM A746, thickness Class 51 unless otherwise shown or specified. Joints on pipe and fittings shall be push-on style and conform to AWWA C110 and AWWA C111, rated for 1.03 MPa (150 psi). Exterior coating shall be approximately 0.025 mm (1 mil) asphaltic coating as specified in ASTM A746. Interior lining shall be a catalyzed coal tar epoxy, having a minimum thickness of 0.60 mm (24 mils), a permeability rating of 0.13 perms, direct impact rating of 11.3 Nm (100 in-lbs), an abrasion resistance of 20 liters of sand per mil, and dielectric strength of 250 volts per mil. Pipe and fittings shall be polyethylene encased with 0.20 mm (8 mil) polyethylene sheeting per AWWA C105. Color of polyethylene encasement shall be green.

Ductile iron fittings shall comply with AWWA C110 and AWWA C111. Fittings shall be polyethylene lined, as specified for ductile iron pipe. Ductile iron fittings shall be polyethylene encased per AWWA C105.

2.2 JOINTING MATERIAL:

A. Gravity Flow Lines:

1. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212. Elastomeric gasket, ASTM F477.
2. Ductile Iron Pipe: Push-on or mechanical joints, AWWA C111, AWWA C110. Flange joints shall comply with AWWA C115. Flange joints shall only be used in vaults or above-grade.

2.3 MANHOLES AND VAULTS:

- A. Manholes and vaults shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. The manholes and vaults shall be in accordance with State Department of Transportation or State Roads Commission standard details, and the following:

1. Precast Concrete Segmental Blocks: Blocks shall conform to ASTM C139 and shall not be less than 150 mm (6 inches) thick for manholes to a depth of 3.6m (12 feet); not less than 200 mm (8 inches) thick for manholes deeper than 3.6m (12 feet) deep. Blocks shall be not less than 200 mm (8 inches) in length. Blocks shall be shaped so that

- joints seal and bond effectively with cement mortar. Parge structure interior and exterior with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.
2. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 3. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 4. Flat top manhole tops shall be reinforced concrete as detailed on the drawings.
 5. Vaults: Reinforced concrete, as indicated on the plans, or precast reinforced concrete. Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C857.
 6. Mortar:
 - a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, 1/4 part lime hydrate, and 3 parts sand.
 - b. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21 L (5-1/2 gallons) per sack of cement.
 7. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M198.
 8. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words "sanitary sewer". The studs and the lettering shall be raised 8 mm (5/16 inch). The cover shall be a minimum of 600 mm (24 inches) in diameter and shall have four 19 mm (3/4 inch) vent holes and two lifting slots. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.

9. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478, Polypropylene shall conform to ASTM D4101. Steps shall be a minimum of 406 mm (16 inches) wide and project a minimum of 178 mm (7 inches) away from the wall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 300 mm (12 inch) centers.
10. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 10 mm (3/8 inch) by 63 mm (2-1/2 inches) spaced a minimum of 400 mm (16 inches) apart. Rungs shall be 35 mm (1-3/8 inches) in diameter and have a non-slip surface. Standoffs shall offset the ladder 180 mm (7 inches) from the wall. The ladder assembly shall be rated for a minimum of 2200 N (500 pounds).

2.4 CONCRETE:

Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03 of these specifications.

2.5 REINFORCING STEEL:

Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.8 CONCRETE PROTECTIVE COATING:

Concrete coating for the interior of wet wells shall consist of an epoxy blended filler sealer, and a cross linked epoxy phenolic cured, resistant protective coating.

2.9 ACID NEUTRALIZATION TANKS:

Acid neutralization tanks shall be constructed of 6 mm (1/4 inch) plate non code mild carbon steel suitable for rubber type lining with all welds double butt, continuous full welded, non porous and ground smooth and having no crevices, offsets or sharpened edges. The bottom and side walls shall be lined with 6 mm (1/4 inch) thermoplastic sheet lining fused directly to white ceramic lining 50 mm (2 inches) thick laid in Permamate acid and alkali proof mortar. The tank shall include 1050 mm (42 inch) ID manway riser constructed of steel shell with an interior corrosion resistant coating and complete cast iron frame and lid at the finish grade. Neutralizing charge shall be limestone, 75 mm (3 inches) in size.

2.10 GATE VALVES:

omitted

2.11 VALVE BOXES:

omitted

2.12 CHECK VALVES

omitted.

2.13 OIL AND GREASE INTERCEPTOR AND GREASE REMOVAL PIT:

omitted

2.14 AIR RELEASE VALVE:

omitted

2.15 CLEANOUT FRAMES AND COVERS:

Frames and covers shall be gray iron casting conforming to ASTM C48. The frame and cover shall be rated for HS20-44 wheel loading, have a studded pattern on its cover, vent holes, and lifting slots. The cover shall fit firmly on the frame without movement when subject to vehicular traffic. The word "SEWER" shall be cast on the cover.

2.16 WARNING TAPE:

Standard, .1mm (4Mil) polyethylene 76 mm (3 inch) wide tape detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

PART 3 - EXECUTION**3.1 BUILDING SERVICE LINES:**

- A. Install sanitary sewer service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.
- B. Connections of service line to building piping shall be made after the new sanitary sewer system has been constructed, tested, and accepted for operation by the Resident Engineer. The Contractor shall install all temporary caps or plugs required for testing.
- C. When building services have not been installed at the time when the sanitary sewer system is complete, provide temporary plugs or caps at the ends of all service lines. Mark the location and depth of the service lines with continuous warning tape placed 300 mm (12 inches) above service lines.

3.2 ABANDONED MANHOLES STRUCTURES AND PIPING:

- A. Manholes and Structures Outside of Building Areas: Remove frame and cover, cut and remove the top of an elevation of 600 mm (2 feet) below finished grade. Fill the remaining portion with compacted gravel or crushed rock or concrete.
- B. Manholes and Structures with Building Areas: Remove frame and cover and remove the entire structure and the base and completely fill the structure with 21 MPa (3,000 psi) concrete.

- C. Piping under and within 1500 mm (5 feet) of building areas shall be completely removed or abandoned in place and completely filled with 21 MPa (3000 psi) concrete.
- D. Piping outside of building areas shall have all ends of the piping at the limit of the abandonment and within structures and manholes, plugged with concrete, and abandoned in-place.
- E. The Contractor shall comply with all OSHA confined space requirements while working within existing manholes and structures.
- F. When the limit of the abandonment terminates in an existing manhole to remain, the flow line in the bench of the manhole to the abandoned line shall be filled with concrete and shaped to maintain the flowline of the lines to remain.

3.3 REGRADING:

- A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.
- C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

3.4 CONNECTIONS TO EXISTING VA OWNED MANHOLES:

- A. During construction of new connections to existing manholes, it shall be the sole responsibility of the Contractor to maintain continued sanitary sewer service to all buildings and users upstream. The contractor shall provide, install, and maintain all pumping, conveyance system, dams, weirs, etc. required to maintain the continuous flow of sewage. All temporary measures required to meet this requirement shall be subject to the review of the Resident Engineer.
- B. Core existing structure, install pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.

- C. The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all pipes connected to the manhole.
- D. Connections and alterations to existing manholes shall be constructed so that finished work conforms as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting and shaping.

3.5 CONNECTIONS TO EXISTING PUBLIC UTILITY COMPANY MANHOLES:

- A. Comply with all rules and regulations of the public utility.
- B. The connection to the existing utility shall comply with the standard details and specifications of the public utility company, except as specifically modified on the plans and specifications.

3.6 PIPE SEPARATION:

- A. Horizontal Separation - Water Mains and Sewers:
 - 1. Existing and proposed water mains shall be at least 3 meters (10 feet) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
 - 2. Gravity flow mains and pressure (force) mains may be located closer than 3 meters (10 feet) but not closer than 1.8 m (6 feet) to a water main when:
 - a. Local conditions prevent a lateral separation of ten feet; and
 - b. The water main invert is at least 450 mm (18 inches) above the crown of the gravity sewer or 600 mm (24 inches) above the crown of the pressure (force) main; and
 - c. The water main is in a separate trench separated by undisturbed earth.
 - 3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe. The pipe for the sanitary sewer main shall comply with the specifications for pressure (force) mains, and the water main material shall comply with Section 33 10 00, WATER UTILITIES. The sewer shall be pressure tested as specified for pressure (force) mains before backfilling.
- B. Vertical Separation - Water Mains and Sewers at Crossings:
 - 1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 600 mm (24 inches) above the crown of gravity flow sewer or 1200 mm (48 inches) above the crown of pressure (force) mains. The vertical separation shall be maintained within 3 meters (10 feet) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.

2. In no case shall pressure (force) sanitary main cross above, or within 600 mm (24 inches) of water lines.
3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 450 mm (18 inches) above or 300 mm (12 inches) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 600 mm (24 inches) below the water line provided both the water line and sewer line are constructed of ductile iron pipe. The pipe for the sewer shall conform to the requirements for pressure sewers specified herein. Piping for the water main shall conform to Section 33 10 00, WATER UTILITIES.
4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 3 meters (10 feet).

3.7 GENERAL PIPING INSTALLATION:

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade. Pressure (force) mains shall have the bells facing the direction of flow.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not lay sewer pipe in same trench with another pipe or other utility. Sanitary sewers shall cross at least 600 mm (2 feet) below water lines.
- H. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 300 mm (12 inches) over the crown of the pipe.
- I. Warning tape shall be continuously placed 300 mm (12 inches) above sewer pipe
- J. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:

3. Polyvinyl Chloride (PVC) Piping: ASTM D2321.

3.8 MANHOLES AND VAULTS:

A. General:

1. Circular Structures:

- a. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
- b. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top, shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
- c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

2. Rectangular Structures:

- a. Reinforced concrete structures shall be installed in accordance with Division 03, CONCRETE.
 - b. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on 200 mm (8 inches) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
 4. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
 - a. Forming directly in concrete base of structure.
 - b. Building up with brick and mortar.
 5. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (1-inch per foot) nor more than 1:6 (2 inches per foot). Bottom slab and benches shall be concrete.

6. The wall that support access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
7. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
8. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inches) thick, by 300 mm (12 inches) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.9 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES:

Reinforced concrete as detailed on the drawings. The concrete shall not restrict access for future maintenance of the joints within the piping system.

3.10 WET WELLS (FIBERGLASS TANK):

omitted

3.11 WET WELLS (PRECAST CONCRETE):

omitted

3.12 DRY WELL AND VAULTS:

omitted

3.13 OIL AND GREASE INTERCEPTOR AND GREASE REMOVAL PIT:

omitted

3.14 ACID NEUTRALIZING TANKS:

- A. Set tank on a 200 mm (8 inches) compacted sand base per the manufacturer's recommendations.
- B. Inspect interior and exterior of the tank and repair all damage to the lining. Place limestone in tank.
- C. Backfill around tank with sand material.

3.15 CLEANOUTS:

- A. 150 millimeters (6 inches) in diameter and consisting of a ductile iron 45 degree fitting on end of run, or combination Y fitting and 1/8 bend in the run with ductile iron pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Center-set cleanouts, located in unpaved areas, in a 300 by 300 by 150 mm (12 by 12 by 6 inches) thick concrete slab set flush with adjacent finished grade. Where cleanout is in force main, provide a blind flange top connection. The center of the flange shall be equipped with a 50 mm (2 inches) base

valve to allow the pressure in the line to be relieved prior to removal of the blind flange. Frames and covers for pressure (force) mains shall be 600 mm (24 inches) in diameter.

- B. The top of the cleanout assembly shall be 50 mm (2 inches) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.16 SETTING OF GATE VALVES:

- A. Avoid setting valves under pavement except where shown on the drawings.
- B. Clean valve interior before installation.
- C. Set valve plumb, restrain ends of valves when indicated on the drawing.
- D. Set valve box cover flush with the finished grade. Valve box shall be centered over the operating nut.

3.17 SETTING OF CHECK VALVES:

- A. Check valves shall be installed in a vault, direct burial of check valves shall not be permitted.
- B. Check valves shall be set in the horizontal position, with adequate clearance to the structure to allow for movement of the lever and maintenance of the valve.
- C. Clean the interior of the valve and check its operation prior to installation.
- D. After installation, adjust the weight on the lever to provide proper operation in accordance with the manufacturer's recommendations.

3.18 SETTING OF AIR RELEASE VALVES:

- A. Set valves in vault with adequate space for maintenance of the valve. The vault shall have a solid floor to prevent all sanitary blowoff from being absorbed into the soils.
- B. Valves shall be set plumb and supported to the vault. Maintain accessibility to the isolation valve on the air valve line.
- C. Install the valve after the completion of testing of the pressure (force) main.

3.19 INSPECTION OF SEWERS:

Inspect and obtain the Resident Engineer's approval. Thoroughly flush out before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lip at joints on the inside of gravity sewer lines are not acceptable.

3.20 TESTING OF SANITARY SEWERS:

- A. Gravity Sewers and Manholes (Select one of the following):
 1. Air Test: Vitrified Clay Pipe ASTM C828. PVC Pipe, Uni-Bell Uni-B-6. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be

- included in the test to prevent air leakage. The line shall be pressurized to 28 kPa (4 psi) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 24 kPa (3.5 psi) greater than the average back-pressure of any groundwater above the sewer. The minimum test time shall be as specified in Uni-Bell Uni-B-6.
2. Exfiltration Test:
- a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 900 mm (3 feet) above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During one hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11 L (3.0 gallons) per hour per 30 m (100 feet).
 - b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.
3. Infiltration Test: If ground water level is greater than 900 mm (3 feet) above invert of the upper manhole, infiltration tests are acceptable. Allowable leakage for this test will be the same as for the exfiltration test.
- B. Pressure (Force) Mains: Test at 690 kPa (100 psi) for two hours. Leakage shall be per the following:

$$L=J*D*\sqrt{P}/4500$$

Where:

L = Maximum Allowable Leakage in Gallons per Hour

J = Number of Joints in Test Area

D = Diameter of Pipe in Inches

P = Average Test Pressure (Psi)

- C. Testing of Fiberglass Sewage Holding Tanks: No leakage at 35 kPa (5 psi) air pressure test with 5:1 safety factor. Test by Contractor after installation.
- D. Testing of Concrete Wet Well: No leakage with the wet well completely filled with water for a duration of 4 hours.

- - - E N D - - -

**SECTION 33 40 00
STORM DRAINAGE UTILITIES**

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies construction of outside, underground storm sewer systems. The storm sewer systems shall be complete and ready for operation, including all drainage structures, frames, grate and covers, connections to new buildings, structure service lines, existing storm sewer lines and existing drainage structures and all required incidentals.

1.2 RELATED WORK:

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheet piling, Bracing: Section 31 20 00, EARTH MOVING.
- C. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- D. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.
- E. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, 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.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to public storm sewer lines and the extension, and/or modifications to Public Utility systems.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturers' Literature and Data: Submit the following as one package:
 - 1. Piping.
 - 2. Jointing material.
 - 3. Manhole, inlet and catch basin material.
 - 4. Frames and covers.

5. Steps.

6. Resilient connectors and downspout boots.

C. One copy of State Department of Transportation standard details of MANHOLES, INLETS and catch basins.

D. One copy of State Department of Transportation specification.

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):

A48-03/A48M-03.....Gray Iron Castings

A536-84(2004).....Ductile Iron Castings

A615-05/A615M-05.....Deformed and Plain-Billet Steel Bars for
Concrete Reinforcement

A655-04e1/A655M-04e1... Reinforced Concrete D-Load Culvert, Storm Drain
and Sewer Pipe

A742-03/A742M-03.....Steel Sheet, Metallic Coated and Polymer
Precoated for Corrugated Steel Pipe

A760-01a/A760M-01a.....Corrugated Steel Pipe, Metallic-Coated for
Sewers and Drains

A762-00/A762M-00.....Corrugated Steel Pipe, Polymer Precoated for
Sewers and Drains

A798-01/M798M-01.....Installing Factory-Made Corrugated Steel Pipe
for Sewers and Other Applications

A849-00.....Post-Applied Coatings, Pavings, and Linings for
Corrugated Steel Sewer and Drainage Pipe

A929-01/A929M-01.....Steel Sheet, Metallic Coated by the Hot Dip
Process for Corrugated Steel Pipe

C76-05a/C76M-05a.....Reinforced Concrete Culvert, Storm Drain and
Sewer Pipe

C139-03.....Concrete Masonry Units for Construction of Catch
Basins and Manholes

C150-04ae1.....Portland Cement

C443-05/C443M-05.....Joints for Concrete Pipe and Manholes, Using
Rubber Gaskets

C478-03a/C478M-03a.....Precast Reinforced Concrete Manhole Sections

C506-05/C506M-05.....Reinforced Concrete Arch Culvert, Storm Drain
and Sewer Pipe

C507-05a/C507M-05a.....Reinforced Concrete Elliptical Culvert, Storm
Drain and Sewer Pipe

- C655-04e1/C655M-04e1....Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
- C1433-04e1/C1433M-04e1..Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers
- C828-03.....Low-Pressure Air Test of Vitrified Clay Pipe Lines
- C857-95(2001).....Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- C923-02/C923M-02.....Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Materials
- C924-02/C924M-02.....Testing Concrete Pipe Sewer Lines by Low Pressure Air Test Method
- C1103-03/C1103M-03.....Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
- D698-00ae1.....Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
- D1056-00.....Flexible Cellular Materials-Sponge or Expanded Rubber
- D2412-02.....Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading
- D2321-04e1.....Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications .
- D3034-04a.....Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- D3212-96a(2003)e1.....Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- D3350-04.....Polyethylene Plastics Pipe and Fittings Materials
- D4101-05a.....Polypropylene Injection and Extrusion Materials
- F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F679-03.....Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- F714-05.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- F794-03.....Poly (Vinyl Chloride)(PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

- F894-98a.....Polyethylene (PE) Large Diameter Profile Wall
Sewer and Drain Pipe
- F949-03.....Poly (Vinyl Chloride) (PVC) Corrugated Sewer
Pipe with Smooth Interior
- F1417-92(2005).....Installation Acceptance of Plastic Gravity Sewer
Lines Using Low-Pressure Air

NOTE: ASTM test methods shall be the current version as of the date of advertisement of the project.

C. American Association of State Highway and Transportation Officials
(AASHTO):

- HB17.....Standard Specifications for Highway Bridges
- M190-04.....Bituminous Coated Corrugated Metal Culvert Pipe
and Pipe Arches
- M198-05.....Joints for Circular Concrete Sewer and Culvert
Pipe Using Flexible Watertight Gaskets
- M294-04.....Corrugated Polyethylene Pipe, 300-1500 mm (12 to
60 inches) Diameter

PART 2 - PRODUCTS

2.1 PIPING:

A. Gravity Lines (Pipe and Appurtenances):

2. Polyvinyl Chloride (PVC):

- a. Pipe and Fittings, Type PSM PVC Pipe, shall conform to ASTM D3034, Type PSM, SDR 35. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D 3212. Gaskets shall conform to ASTM F 477. Solvent welded joints shall not be permitted.
- b. Pipe and fittings, smooth wall PVC, shall conform to the following:
 - 3) Solid wall pipe and fittings shall conform to ASTM F 679, SDR 26 pipe and fittings shall gaskets conforming to ASTM F 477, and shall be able to withstand a hydrostatic pressure of 345 kPa (50 psi).

2.2 JOINTING MATERIAL:

A. Concrete Pipe: Rubber gasket ASTM C443.

B. Polyvinyl Chloride (PVC) Pipe:

1. PVC Plastic Pipe: Joints shall comply with ASTM D3212, Elastomeric Gaskets shall comply with ASTM F477 and as recommended by the manufacturer.

2.3 MANHOLES, INLETS AND CATCH BASINS:

- A. Manholes, inlets and catch basins shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. Manholes, inlets and catch basins shall be in accordance with State Department of Transportation standard details, and the following VA requirements, in case of variance, VA requirements supersede:
1. Precast Concrete Segmental Blocks: Blocks shall conform to ASTM C139 and shall not be less than 150 mm (6 inches) thick for manholes to a depth of 3.6 m (12 feet); not less than 200 mm (8 inches) thick for manholes deeper than 3.6 m (12 feet) deep. Blocks shall be not less than 200 mm (8 inches) in length. Blocks shall be shaped so that joints seal and bond effectively with cement mortar. Parge structure interior and exterior with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.
 2. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 3. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 4. Flat top manhole tops shall be reinforced concrete as detailed on the drawings.
 5. Precast Catch Basins: Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C-857.
 6. Mortar:
 - a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, 1/4 part lime hydrate, and 3 parts sand.
 - b. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21L (5-1/2 gallons) per sack of cement.
 7. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections,

and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M-198B.

8. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words "storm sewer". The studs and the lettering shall be raised 8 mm (5/16 inch). The cover shall be a minimum of 600 mm (24 inches) in diameter and shall have four 19 mm (3/4 inch) vent holes and two lifting slots. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
9. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478, Polypropylene shall conform to ASTM D4101. Steps shall be a minimum of 250 mm (10 inches) wide and project a minimum of 125 mm (5 inches) away from the wall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 300 mm (12 inch) centers.
10. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 9 mm (3/8 inch) by 63 mm (2-1/2 inches) spaced a minimum of 400 mm (16 inches) apart. Rungs shall be 35 mm (1-3/8 inches) in diameter and have a non-slip surface. Standoffs shall offset the ladder 180 mm (7 inches) from the wall. The ladder assembly shall be rated for a minimum of 2200 N (500 pounds).
- B. Prefabricated Corrugated Metal Manholes: Manholes shall be the type and design as indicated on the drawings and as recommended by the manufacturer.
- C. Prefabricated Plastic Manholes and Drain Basins: Plastic manholes and drain basins shall be as indicated on the drawings.
- D. Frame and Cover for Gratings: Frame and cover for gratings shall be in accordance with State Department of Transportation standard details. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the drawings.

2.4 HEADWALLS:

- A. Headwalls shall be cast-in-place concrete and in accordance with State Department of Transportation standard details. Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03 of these specifications.

2.5 CONCRETE:

Concrete shall have a minimum compressive strength of 5000 psi at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform to the provisions of Division 03 of these specifications.

2.6 REINFORCING STEEL:

Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.7 FLARED END SECTIONS:

Flared End Sections: Sections shall be of standard design fabricated from zinc-coated steel sheets conforming to requirements of ASTM A929.

2.8 PRECAST REINFORCED CONCRETE BOX.

Precast Reinforced Concrete Box: For highway loadings with 600 mm (2 feet) of cover or more subjected to dead load only, conform to ASTM C1433; For less than 600 mm (2 feet) of cover subjected to highway loading, conform to ASTM C1433.

2.9 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS:

- A. Resilient Connectors: Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.
- B. Downspout Boots: Boots used to connect exterior downspouts to the storm drainage system shall be of gray cast iron conforming to ASTM A48, Class 30B or 35B.

2.10 WARNING TAPE:

Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

2.11 TRENCH DRAIN:

- A. The surface drainage system shall be 6" x 3'-0" polymer concrete with fiberglass grate as manufactured by ACO Polymer Products, Inc., 1.800.543.4764, or approved equal.
- B. Provide 4" outlet cap, model: SK208-6 to connect to 4" PP pipe.
- C. Channels to be manufactured from polyester resin polymer concrete with integrally cast in ductile iron rail and supplied with fiberglass grates.
- D. The system shall be 4 inches (100mm) nominal inside width with a 6.3 in. (160mm) overall width and a built-in slope of 0.6%.
- E. All channels shall be interlocking with a male/female joint. Each channel shall have a 4.5 in. schedule 40 round and 4 in. oval drill-out on the bottom for vertical connection with underground piping.
- F. The complete drainage system shall be by ACO Polymer Products, Inc. Any deviation or partial system design and/or improper installation will void any and all warranties provided by ACO Polymer Products, Inc.
- G. The channel system shall be independently certified to withstand loadings to load Class F (DIN19580). Grates shall be secured using

'Powerlok' boltless locking system. Grate and locking system shall be fully removable from channel.

H. Polymer concrete shall have material properties of: compressive strength range between 14,000-14,500 psi; flexural strength between 3600-4500 psi; tensile strength of 1500 psi. The material water absorption rate shall not exceed 0.05% by weight and shall be resistant to prolonged salt exposure, repetitive frost cycles and chemically resistant to dilute acids and alkalis.

I. The trench drain system shall be installed in accordance with the manufacturer's installation instructions and recommendations.

2.12 ROUND COMPRESSION SEAL TYPE BACKWATER VALVE

1. Supply and install where indicated on the drawings a 4" backwater valve complete with neoprene body and float, metal flange and seat and brass compression screws.
2. Install as per manufacturer's recommendations.
3. Valve shall be as manufactured by Jay R. Smith Mfg. Co. or equal.

PART 3 - EXECUTION

3.1 EXCAVATION FOR STORM DRAINS AND DRAINAGE STRUCTURES:

Excavation of trenches and for appurtenances and backfilling for storm drains, shall be in accordance with the applicable portions of Section 31 20 00, EARTH MOVING.

3.2 PIPE BEDDING:

The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

3.3 GENERAL PIPING INSTALLATION:

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.

- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not lay sewer pipe in same trench with another pipe or other utility.
- H. Do not walk on pipe in trenches until covered by layers of shading to a depth of 300 mm (12 inches) over the crown of the pipe.
- I. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
 - 2. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
- J. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.

3.4 REGRADING:

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.
- C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

3.5 CONNECTIONS TO EXISTING VA-OWNED MANHOLES:

Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.6 CONNECTIONS TO EXISTING PUBLIC UTILITY MANHOLES:

- A. Comply with all rules and regulations of the public utility.
- B. The connection to the existing utility shall comply with the standard details and specifications of the public utility company, except as specifically modified on the plans and specifications.

3.7 MANHOLES, INLETS AND CATCH BASINS:

A. General:

1. Circular Structures:

- a. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
- b. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
- c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

2. Rectangular Structures:

- a. Reinforced concrete structures shall be installed in accordance with Division 03, CONCRETE of these specifications.
- b. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on a 200 mm (8 inches) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D 698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.

3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.

4. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:

- a. Forming directly in concrete base of structure.
- b. Building up with brick and mortar.

5. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (25mm per 300mm, 1-inch per foot) nor more than 1:6 (50mm per 300mm, 2 inches per foot). Bottom slab and benches shall be concrete.
6. The wall that supports access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
7. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
8. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inches) thick, by 300 mm (12 inches) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.8 CURB INLETS, CATCH BASINS, AND AREA DRAINS:

Reinforced concrete as shown or precast concrete.

3.9 INSPECTION OF SEWERS:

Inspect and obtain the Resident Engineer's approval. Thoroughly flush out before inspection. Lamp between structures and show full bore indicating sewer is true to line and grade. Lip at joints on inside of sewer is prohibited.

3.10 TESTING OF STORM SEWERS:

A. Gravity Sewers (Select one of the following):

1. Air Test: Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
2. Exfiltration Test:
 - a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 900 mm (3 feet) above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During 1 hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11L (3.0 gallons) per hour per 30 m (100 feet).

- b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.

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SECTION 34 71 13
VEHICLE BARRIERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes passive High-Security Vehicle Barricades of fixed bollards of K4 crash resistance rating.

1.2 RELATED WORK

- A. Section 32 12 16, ASPHALT PAVING, for asphalt driveway and approach paving.
- B. Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS, for concrete driveway and approach paving.
- C. Section 03 30 00, CAST-IN-PLACE CONCRETE, for concrete islands and curbing.
- D. Section 05 50 00, METAL FABRICATIONS, for pipe bollards to protect parking control equipment.

1.3 SYSTEM DESCRIPTION

- A. Barricade system mounted in the ground as detailed on the drawings.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Indicate dimensions, required clearances, method of field assembly, and location and size of each field connection.
- C. Certificate test reports confirming compliance's with specified resistive rating.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1.6 PERFORMANCE

- A. Performance Evaluation. All passive vehicle barriers shall be certified for their resistance to ramming according to "Test Method of Vehicle Crash Testing of Perimeter Barriers and Gates" SD-STD-02.01 Revision A March 2003.
- B. The system shall have been certified by the United States Department of State to have a performance evaluation per Department of State D.O.S. Specification SDSDT- 0201.

1. STOPPING CAPACITY.
2. Normal Operation. Vehicle barrier(s) shall provide excellent security and positive control of normal traffic in both directions by providing an almost insurmountable obstacle to non-armored or non-tracked vehicles.

1.7 COORDINATION

Coordinate installation of anchorages for parking control equipment. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.8 APPLICABLE PUBLICATIONS:

Department of State D.O.S. Specification SDSDT- 0201.

PART 3-EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, critical dimensions, and other conditions affecting performance.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Install Bollards in concrete foundation pad as outlined in manufactures installation instructions.

3.3 FIELD QUALITY CONTROL

Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

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