

Replace Underground Steam Mains

Project No. 575-14-105

Construction Specifications

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Department of Veterans Affairs
Grand Junction VA Medical Center
Grand Junction, CO 81501



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TABLE OF CONTENTS

DIVISION 00 - SPECIAL SECTIONS

00 01 15 List of Drawing Sheets

DIVISION 01 - GENERAL REQUIREMENTS

01 00 00 General Requirements
01 33 23 Shop Drawings, Product Data, and Samples
01 35 26 Safety Requirements
01 42 19 Reference Standards
01 45 29 Testing Laboratory Services
01 57 19 Temporary Environmental Controls
01 74 19 Construction Waste Management
01 81 11 Sustainable Design Requirements

DIVISION 02 – EXISTING CONDITIONS

02 21 00 Site Surveys
02 41 00 Demolition

DIVISION 03 – CONCRETE

03 30 53 (Short-Form) Cast-in-Place Concrete

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07 84 00 Firestopping

DIVISION 09 – FINISHES

09 91 00 Painting

DIVISION 13 - SPECIAL CONSTRUCTION

13 05 41 Seismic Restraint Requirements for Non-Structural Components

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

23 05 10 Common Work Results for Boiler Plant and Steam Generation
23 07 11 HVAC and Boiler Plant Insulation
23 22 13 Steam and Condensate Heating Piping
23 22 23 Steam Condensate Pumps

DIVISION 26 – ELECTRICAL

26 05 11 Requirements for Electrical Installations
26 05 19 Low-Voltage Electrical Power Conductors and Cables
26 05 26 Grounding and Bonding for Electrical Systems
26 05 33 Raceway and Boxes for Electrical Systems
26 27 26 Wiring Devices

DIVISION 31 – EARTHWORK

31 20 11 Earth Moving (Short Form)
31 23 19 Dewatering

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 05 23 Cement and Concrete for Exterior Improvements
32 12 16 Asphalt Paving
32 84 00 Planting Irrigation
32 90 00 Planting

DIVISION 33 – UTILITIES

33 63 00 Steam Energy Distribution

-- End of Section --

SECTION 00 01 15 LIST OF DRAWING SHEETS

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

<u>SEQUENCE</u>	<u>SHEET NO.</u>	<u>SHEET TITLE</u>
1	GI-1	AREA MAP, SITE PLAN, SHEET INDEX
2	GI-2	GENERAL NOTES, PHASING PLAN, ABBREVIATIONS
3	GI-3	SITE PLAN
4	MD-1	DEMOLITION PARTIAL SITE PLAN
5	MD-2	DEMOLITION PARTIAL SITE PLAN
6	MD-3	DEMOLITION PARTIAL SITE PLAN
7	MD-4	DEMOLITION BUILDINGS 1, 5, 6, 7, 8, 9
8	MD-5	DEMOLITION BUILDINGS 12, 13, 14, 20
9	MS-1	PARTIAL SITE PLAN
10	MS-2	PARTIAL SITE PLAN
11	MS-3	PARTIAL SITE PLAN
12	MP-1	BUILDINGS 1, 5, 6, 7, 8, 9
13	MP-2	BUILDING 12, 13, 14, 20
14	MP-3	DETAILS
15	MP-4	DETAILS
16	MP-5	DETAILS
17	MP-6	SCHEDULES AND DIAGRAMS
18	MP-7	PHOTOS

-- End Of Section --

SECTION 01 00 00

GENERAL REQUIREMENTS

1.1 GENERAL INTENTION

- A. Contractor shall completely prepare site for operations, including demolition and removal of existing steam and condensate piping, manholes, condensate pumps, etc., and furnish labor and materials 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 Lanier Contracting Services, Inc., as Architect-Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.
- D. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the Contracting Officer Representative (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 Resident Engineer.
- 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.

1.2 STATEMENT OF BID ITEM(S)

- A. General Construction: Work includes general construction, alterations to roads, walks, grading, drainage, mechanical and electrical work, utility systems, necessary removal of existing steam and condensate piping and certain other items.
- B. BASE BID: All work in the drawings and specifications, including:
 - 1. Demolition of existing 1981 vintage direct-buried ("Perma-Pipe") steam and condensate piping.
 - 2. Existing concrete trench system to be abandoned in-place. Demolish as required for new piping installation.
 - 3. Demolition of existing manholes.
 - 4. Installation of new pre-engineered, direct-buried, drainable-dryable-testable (DDT) steam and condensate piping system.
 - 5. Refurbishment of existing manhole including lighting, sump pumps, etc.

6. Demolition of existing condensate and vacuum return units.
 7. Installation of new pumping trap packages and condensate return unit (electrical).
- C. ALTERNATE BID ITEMS (DEDUCTIVE): Any new work required by the Alternate Bid Items shall comply with all provisions of the specifications and drawings.
1. ALTERNATE #1 (DEDUCT) – INSTALLATION OF STEAM AND CONDENSATE PIPING FROM BUILDING 6 TO BUILDING 5

Any work related to the installation of steam and condensate piping from Building 6 to Building 5. Demolition of the existing piping system from Building 6 to Building 5 remains in the base bid. The wall penetrations resulting from the demolition of the existing steam and condensate piping shall be sealed watertight. Any open trenches created by the demolition of existing piping shall be backfilled and the surface restored to its pre-project conditions.
 2. ALTERNATE #2 (DEDUCT) – INSTALLATION OF STEAM AND CONDENSATE BRANCH PIPING TO BUILDING 14

Any work related to the installation of steam and condensate branch piping to Building 14, including tees in the main 2.5" LPS and 1.25" LPR. The demolition of the steam and condensate branch lines to Building 14 remain in the base bid. The wall penetrations resulting from the demolition of the existing steam and condensate piping shall be sealed watertight. Any open trenches created by the demolition of existing steam and condensate piping shall be backfilled and the surface restored to its pre-project conditions.
 3. ALTERNATE #3 (DEDUCT) – SOME WORK IN BUILDING 1 SOUTH BASEMENT MECHANICAL ROOM

Any work related to the demolition of the existing condensate return and vacuum return units in Building 1 South Basement Mechanical Room. Any work related to the installation of new Pumping Trap Package (PTP-1) in Building 1 South Basement Mechanical Room. Any work related to the installation of combination steam trap/pump in the Building 1 South Basement Mechanical Room.
 4. ALTERNATE #4 (DEDUCT) – DEMOLITION OF VACUUM RETURN UNIT AND INSTALLATION OF PTP-1 IN BUILDING 1 OPA CRAWLSPACE

Any work related to the demolition of the existing vacuum return unit in Building 1 OPA crawlspace. Any work related to the installation of the Pumping Trap Package (PTP-1) (OPA) in the Building 1 OPA crawlspace. The access door into Building 1 OPA crawlspace shall remain in the base bid.

5. ALTERNATE #5 (DEDUCT) – DEMOLITION AND INSTALLATION OF CONDENSATE RETURN UNIT IN BUILDING 20
Any work related to the demolition of the existing condensate return unit in Building 20. Any work related to the installation of the electric condensate return unit in Building 20.
6. ALTERNATE #6 (DEDUCT) – DEMOLITION OF VACUUM RETURN UNIT AND INSTALLATION OF PTP-5 IN BUILDING 5
Any work related to the demolition of the existing vacuum return unit in Building 5. Any work related to the installation of the Pumping Trap Package (PTP-5) in Building 5. If this alternate is executed and Alternate #1 is not executed, a minimum 12” diameter by 36” long vented horizontal flash tank shall be installed in Building 5 South Basement Mechanical Room. The high pressure drip line shall be routed to this tank and the discharge from the tank shall be routed to the existing condensate return unit. Include all necessary piping, fittings, hangers, attachments, etc. as required for a fully functional flash tank installation.
7. ALTERNATE #7 (DEDUCT) – SOME WORK IN BUILDING 6
Any work related to the demolition of the vacuum return and condensate return units in Building 6. Any work related to the demolition of the existing flash tank in Building 6. Any work related to the installation of Pumping Trap Package (PTP-6) in Building 6.
8. ALTERNATE #8 (DEDUCT) – INSTALLATION OF PTP-8 AND FLASH TANK IN BUILDING 8
Any work related to the installation of Pumping Trap Package (PTP-8) in Building 8. A 4” diameter by 24” long vented horizontal flash tank shall be installed in Building 8 Mechanical Room. The high pressure drip line shall be routed to this tank and the discharge from the tank shall be routed to the existing condensate return unit. Include all necessary piping, fittings, hangers, attachments, etc. as required for a fully functional flash tank installation.
9. ALTERNATE #9 (DEDUCT) – DEMOLITION OF VACUUM RETURN UNIT AND INSTALLATION OF PTP-9 IN BUILDING 9
An work related to the demolition of existing vacuum return unit in Building 9 Basement Mechanical Room. Any work related to the installation of Pumping Trap Package (PTP-9) in Building 9 Basement Mechanical Room.
10. ALTERNATE #10 (DEDUCT) – SOME WORK IN BUILDING 13
Any work related to the demolition of the existing vacuum return and condensate return pump units in Building 13 Basement Mechanical Room. Any work related to the installation of Pumping Trap Package (PTP-13) in Building 13 Basement Mechanical Room.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. After award of contract, 1 set of specifications and drawings will be furnished.
- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense.

1.4 CONSTRUCTION SECURITY REQUIREMENTS

A. Security Plan:

- 1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
- 2. The General Contractor is responsible for assuring that all 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. Key Control: 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.

D. Document Control:

- 1. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
- 2. 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".

3. 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. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
 - a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
 - b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

E. Motor Vehicle Restrictions

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

1.5 OPERATIONS AND STORAGE AREAS

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.
- B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

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

(FAR 52.236-10)

- D. Working space and space available for storing materials shall be as determined by the COR.
- E. Workmen are subject to rules of Medical Center applicable to their conduct.
- F. Keep roads clear of construction materials, debris, standing construction equipment and vehicles at all times.
- G. 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. Do not store materials and equipment in other than assigned areas.
- H. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR. All such actions shall be coordinated with the Utility Company involved:
- I. Phasing: To insure such executions, Contractor shall furnish the COR with a schedule of approximate phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, Contractor shall notify the COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such phasing dates to insure accomplishment of this work in successive phases mutually agreeable to Medical Center Director, COR and Contractor, as follows:
1. Portions of work which require shutdown of the main steam service to the buildings, including the direct-buried steam and condensate piping shall be performed in the summer months of June, July, and August.
 2. The Main Hospital complex and the Laundry Plant shall not be taken out of service simultaneously, except for prior approved short duration shutdowns, as required for disconnection and reconnection of the steam and condensate service. The Main Hospital shall have a continuous source of steam.

3. Provide flexible steam hosing from Central Plant to Building 1 and Building 13, as required.
 4. Provide additional tie-in points, including gate valves, etc. as required.
 5. Provide temporary trenches, traffic plates, traffic barriers, etc. as required.
 6. Coordinate location of temporary steam hose routing with the COR.
 7. At the discretion of the VA, the Contractor may propose an alternate method of providing steam and condensate service to the Hospital and Laundry, such as mobile plant, etc.
- J. Occupied Buildings:
1. Buildings Number 1, 5, 6, 7, 8, 9, 12, 13, 14, and 20 will be occupied during performance of work.
 2. Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas to be used in the Medical Centers operations will not be hindered. Contractor shall permit access to Department of Veterans Affairs personnel and patients through other construction areas which serve as routes of access to such affected areas and equipment. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Medical Center operations will continue during the construction period.
- K. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2.1 m (seven feet) minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375 mm (15 inches). Bottom of fences shall extend to 25 mm (one inch) above grade. Remove the fence when directed by COR.
- L. Utilities Services: Maintain existing utility services for Medical Center at all times. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR.
1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the Medical Center Director's prior knowledge and written

- approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 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. Approval shall be confirmed in writing as soon as practical.
- M. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged.
- N. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:
1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.
 2. Provide steel plates to cover open trenches in roadways. Make sure they are suitable for truck traffic.
 3. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR.
- O. Coordinate the work for this contract with other construction operations as directed by COR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

1.6 ALTERATIONS

A. Survey:

1. Before any work is started, the Contractor shall make a thorough survey with the COR and/or Contracting Officer. The survey shall be of the existing site at the locations of all demolition and new construction to observe the existing condition of the curbs, gutters, pavement, grass, shrubs, trees, ground cover, landscaped areas, etc.

2. During this site walk, digital photographs shall be taken of all areas to be disturbed by this project. These photographs will be used by the COR and Contracting Officer at job completion to determine if each individual area has been restored to its existing condition. These photographs shall be numerous enough to depict all areas and as directed by the Contracting Officer; 200 photos at a minimum shall be taken. A photo album shall be created.
3. Present a report listing any discrepancies between drawings and existing conditions at the site.
4. 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. Re-Survey:

1. Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of demolition, of new construction and of buildings involved. Furnish a report on conditions then existing, of surfaces as compared with conditions of same as noted in first condition survey report.
2. Re-survey report shall also list any damage caused by Contractor to such 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.
3. At the conclusion of the re-survey, the contractor shall present the COR with a photo album and two (2) CDs of all pictures.

C. Protection: Provide the following protective measures:

1. 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.
2. Protection of interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, floor surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

1.7 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. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center.

2. 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.

1.8 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:

1. Designating areas for equipment maintenance and repair;
2. Providing waste receptacles at convenient locations and provide regular collection of wastes;
3. Providing adequately maintained sanitary facilities.
4. Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
5. Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and

1.9 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).

1.10 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 marked-up 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.

1.11 USE OF ROADWAYS

For hauling, use only established public roads and roads on Medical Center property. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

1.12 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. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.
- B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.
- C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

1.13 TEMPORARY TOILETS

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.

1.14 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The Contractor shall carefully conserve any utilities furnished without charge.
- B. Heat:
 - 1. 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:
 - 2. Obtain heat by connecting to Medical Center heating distribution system.
 - 3. Steam is available at no cost to Contractor.
- C. Electricity (for Construction and Testing):
 - 1. Furnish all temporary electric services.
 - 2. 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.
- D. Water (for Construction and Testing): Furnish temporary water service.
 - 1. Obtain water by connecting to the Medical Center water distribution system. 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.
- E. Steam: Furnish steam system for testing required.
 - 1. Obtain steam for testing by connecting to the Medical Center steam distribution system. Steam is available at no cost to the Contractor.

2. Maintain connections, pipe, fittings and fixtures and conserve steam-use so none is wasted. Failure to stop leakage or other waste will be cause for revocation (at COR's discretion), of use of steam from the Medical Center's system.

1.15 TESTS

- A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.
- B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the Contracting Officer. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.
- C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire complex which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, steam, chilled water, refrigerant, hot water, controls and electricity, etc. Another example of a complex which involves several components of different disciplines is a boiler installation. Efficient and acceptable boiler operation depends upon the coordination and proper operation of fuel, combustion air, controls, steam, feedwater, condensate and other related components.
- D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.
- E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.16 INSTRUCTIONS

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

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

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

1.17 VA TRIRIGA CPMS

- A. VA contractors, selected by award to perform work, are required to get access to the VA TRIRIGA CPMS. The TRIRIGA CPMS is the management and collaborative environment that the VA uses for all Major, Minor and Non-Recurring Maintenance (NRM) projects within the Office of Construction & Facilities Management (CFM), Veterans Health Administration (VHA), National Cemetery Administration (NCA), and the Veterans Benefits Administration (VBA).
- B. The contractor is solely responsible for acquiring access to the VA TRIRIGA CPMS.
- C. To gain access to the VA TRIRIGA CPMS the contractor is encouraged to follow the licensing process outline as specified below:
- D. Requirement: TRIRIGA is the management and collaborative environment that VA uses for all construction projects. VA requires its contractors to procure TRIRIGA access as part of the cost of performance for a VA construction related contract.
- E. Access Request and Payment can be made through the following URL:
<https://valicensing.oncfi.com/>

- F. Inquiries or to request additional services, contact the following:
Craig Alsheimer, Federal Account Manager
Computerized Facility Integrations, LLC
18000 West Nine Mile Road, Suite 700
Southfield, MI 48075
Email: calsheimer@gocfi.com
Phone: 248-557-4234 Extension 6010; 410-292-7006
- G. Process:
1. Once the contractor has been notified by VA of the award and a unique contract number, the contractor can enter a request for access to TRIRIGA at URL <https://valicensing.oncfi.com/>
 2. CFI will process the request for access and payment. CFI will create the USER ID and a password. Security provisions required to align the contractor to the Contract Number will be entered and an email will be generated and submitted to the requestor.
 3. CFI will also provide standard terms and conditions related to the transaction and use agreement.

-- End of Section --

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. Complete, detailed and completely marked submittals are required. Multiple submittals are acceptable. Each cut sheet must be marked to completely identify the item proposed. When multiple items are required, correlate each item with the plans and specs. Everything that is presented in each submittal must be complete and adequately marked or the entire submittal will be rejected without review. Complete means:
 - A. All items must be clearly marked for tag number, model number, size, part number, accessories, options, materials, class, ratings, design data, performance, and any other installation details as necessary to evaluate the suitability of the item to meet the intent of the design;
 - B. Multiple items require individual tag numbers, multiple, keyed marks or multiple sheets and separate designations where each item or group of items will be installed;
 - C. The quantity and location of each item must be designated;
 - D. Include performance capabilities certified by the manufacturer;
 - E. Each item must be referenced to the specification paragraph using the complete paragraph number.
- 1-4. Any submittal item judged as not complete may cause the entire submittal to be immediately rejected without review. Only one re-submittal is allowed. Submittal data which are marked "no exceptions taken" do not relieve the contractor from the responsibility to comply with the plans and specifications.
- 1-5. 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.
- 1-6. 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.
- 1-7. 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.
- 1-8. 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.
- 1-9. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefore by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.
- 1-10. 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.
- 1-11. 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 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 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. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.

2. The transmittal 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.
 3. Each 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.
- 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. Submittal drawings (shop 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. Reproducible shall be full size.
 2. For each drawing required, submit one legible photographic paper or vellum reproducible.

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.
- 1-12. Shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to:

Lanier Contracting Services

812 Grayson Road

Pleasant Hill, CA 94523

leeann@laniercontractingservices.com

brad@laniercontractingservices.com

- 1-13. At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the COR.

-- End of Section --

SECTION 01 35 26 SAFETY REQUIREMENTS

1.1 APPLICABLE PUBLICATIONS:

- A. The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:
- B. American Society of Safety Engineers (ASSE):
- | | |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A10.1-2011 | Pre-Project & Pre-Task Safety and Health Planning |
| A10.34-2012 | Protection of the Public on or Adjacent to Construction Sites |
| A10.38-2013 | Basic Elements of an Employer's Program to Provide a Safe and Healthful Work Environment
American National Standard Construction and Demolition Operations |
- C. American Society for Testing and Materials (ASTM):
- | | |
|----------|-------------------------------------------------------|
| E84-2013 | Surface Burning Characteristics of Building Materials |
|----------|-------------------------------------------------------|
- D. The Facilities Guidelines Institute (FGI):
- | | |
|---------------------|-----------------------------------------------------------------|
| FGI Guidelines-2010 | Guidelines for Design and Construction of Healthcare Facilities |
|---------------------|-----------------------------------------------------------------|
- E. National Fire Protection Association (NFPA):
- | | |
|----------|-------------------------------------------------------------------------------|
| 10-2013 | Standard for Portable Fire Extinguishers |
| 30-2012 | Flammable and Combustible Liquids Code |
| 51B-2014 | Standard for Fire Prevention During Welding, Cutting and Other Hot Work |
| 70-2014 | National Electrical Code |
| 70B-2013 | Recommended Practice for Electrical Equipment Maintenance |
| 70E-2012 | Standard for Electrical Safety in the Workplace |
| 99-2012 | Health Care Facilities Code |
| 241-2013 | Standard for Safeguarding Construction, Alteration, and Demolition Operations |
- F. The Joint Commission (TJC):
- | | |
|------------|------------------------------------------------------|
| TJC Manual | Comprehensive Accreditation and Certification Manual |
|------------|------------------------------------------------------|

- G. U.S. Nuclear Regulatory Commission:
 - 10 CFR 20 Standards for Protection Against Radiation
- H. U.S. Occupational Safety and Health Administration (OSHA):
 - 29 CFR 1904 Reporting and Recording Injuries & Illnesses
 - 29 CFR 1910 Safety and Health Regulations for General Industry
 - 29 CFR 1926 Safety and Health Regulations for Construction Industry
 - CPL 2-0.124 Multi-Employer Citation Policy
- I. VHA Directive 2005-007

1.2 DEFINITIONS:

- A. OSHA "Competent Person" (CP). One who is capable of identifying existing and predictable hazards in the surroundings and working conditions which are unsanitary, hazardous or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them (see 29 CFR 1926.32(f)).
- B. "Qualified Person" means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project.
- C. High Visibility Accident. Any mishap which may generate publicity or high visibility.
- D. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.
- E. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:
 - 1. Death, regardless of the time between the injury and death, or the length of the illness;
 - 2. Days away from work (any time lost after day of injury/illness onset);
 - 3. Restricted work;
 - 4. Transfer to another job;
 - 5. Medical treatment beyond first aid;
 - 6. Loss of consciousness; or
 - 7. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

1.3 REGULATORY REQUIREMENTS:

- A. In addition to the detailed requirements included in the provisions of this contract, comply with 29 CFR 1926, comply with 29 CFR 1910 as incorporated by reference within 29 CFR 1926, comply with ASSE A10.34, and all applicable federal, state, and local laws, ordinances, criteria, rules and regulations for the State of Colorado. Submit matters of interpretation of standards for resolution before starting work. Where the

requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern except with specific approval and acceptance by the COR.

1.4 ACCIDENT PREVENTION PLAN (APP):

- A. The APP (aka Construction Safety & Health Plan) shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and ensure it is site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all worksite safety and health of each subcontractor(s). Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.
- B. The APP shall be prepared as follows:
1. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards pertaining to the contract (model language can be found in ASSE A10.33). Specifically articulating the safety requirements found within these VA contract safety specifications.
 2. Address both the Prime Contractors and the subcontractors work operations.
 3. State measures to be taken to control hazards associated with materials, services, or equipment provided by suppliers.
 4. Address all the elements/sub-elements and in order as follows:
 - a. **SIGNATURE SHEET.** Title, signature, and phone number of the following:
 - 1) Plan preparer (Qualified Person such as corporate safety staff person or contracted Certified Safety Professional with construction safety experience);
 - 2) Plan approver (company/corporate officers authorized to obligate the company);
 - 3) Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional). Provide concurrence of other applicable corporate and project personnel (Contractor).
 - b. **BACKGROUND INFORMATION.** List the following:
 - 1) Contractor;
 - 2) Contract number;
 - 3) Project name;
 - 4) Brief project description, description of work to be performed, and location; phases of work anticipated (these will require an AHA).
 - c. **STATEMENT OF SAFETY AND HEALTH POLICY.** Provide a copy of current corporate/company Safety and Health Policy Statement, detailing

commitment to providing a safe and healthful workplace for all employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided.

- d. **RESPONSIBILITIES AND LINES OF AUTHORITIES.** Provide the following:
- 1) A statement of the employer's ultimate responsibility for the implementation of his SOH program;
 - 2) Identification and accountability of personnel responsible for safety at both corporate and project level. Contracts specifically requiring safety or industrial hygiene personnel shall include a copy of their resumes.
 - 3) The names of Competent and/or Qualified Person(s) and proof of competency and qualifications to meet specific OSHA Competent and Qualified Person(s) requirements must be attached.;
 - 4) Requirements that no work shall be performed unless a designated competent person is present on the job site;
 - 5) Requirements for pre-task Activity Hazard Analysis (AHAs);
 - 6) Lines of authority;
 - 7) Policies and procedures regarding noncompliance with safety requirements (to include disciplinary actions for violation of safety requirements) should be identified;
- e. **SUBCONTRACTORS AND SUPPLIERS.** If applicable, provide procedures for coordinating SOH activities with other employers on the job site:
- 1) Identification of subcontractors and suppliers (if known);
 - 2) Safety responsibilities of subcontractors and suppliers.
- f. **TRAINING.**
- 1) Site-specific SOH orientation training at the time of initial hire or assignment to the project for every employee before working on the project site is required.
 - 2) Mandatory training and certifications that are applicable to this project (e.g., explosive actuated tools, crane operator, rigger, crane signal person, fall protection, electrical lockout/NFPA 70E, machine/equipment lockout, confined space, etc...) and any requirements for periodic retraining/recertification are required.
 - 3) Procedures for ongoing safety and health training for supervisors and employees shall be established to address changes in site hazards/conditions.
 - 4) OSHA 10-hour training is required for all workers on site and the OSHA 30-hour training is required for Trade Competent Persons (CPs)

- g. **SAFETY AND HEALTH INSPECTIONS.**
- 1) Specific assignment of responsibilities for a minimum daily job site safety and health inspection during periods of work activity: Who will conduct (e.g., "Site Safety and Health CP"), proof of inspector's training/qualifications, when inspections will be conducted, procedures for documentation, deficiency tracking system, and follow-up procedures.
 - 2) Any external inspections/certifications that may be required (e.g., contracted CSP or CSHT).
- h. **ACCIDENT INVESTIGATION & REPORTING.** The Contractor shall conduct mishap investigations of all OSHA Recordable Incidents. The APP shall include accident/incident investigation procedure and identify person(s) responsible to provide the following to the COR:
- 1) Exposure data (man-hours worked);
 - 2) Accident investigations, reports, and logs.
- i. **PLANS (PROGRAMS, PROCEDURES) REQUIRED.** Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational risks in site-specific compliance and accident prevention plans. These Plans shall include but are not be limited to procedures for addressing the risks associates with the following:
- 1) Emergency response;
 - 2) Contingency for severe weather;
 - 3) Fire Prevention;
 - 4) Medical Support;
 - 5) Posting of emergency telephone numbers;
 - 6) Prevention of alcohol and drug abuse;
 - 7) Site sanitation (housekeeping, drinking water, toilets);
 - 8) Night operations and lighting;
 - 9) Hazard communication program;
 - 10) Welding/Cutting "Hot" work;
 - 11) Electrical Safe Work Practices (Electrical LOTO/NFPA 70E);
 - 12) General Electrical Safety;
 - 13) Hazardous energy control (Machine LOTO);
 - 14) Site-Specific Fall Protection & Prevention;
 - 15) Excavation/trenching;
 - 16) Asbestos abatement;
 - 17) Lead abatement;
 - 18) Crane Critical lift;

- 19) Respiratory protection;
 - 20) Health hazard control program;
 - 21) Radiation Safety Program;
 - 22) Abrasive blasting;
 - 23) Heat/Cold Stress Monitoring;
 - 24) Crystalline Silica Monitoring (Assessment);
 - 25) Demolition plan (to include engineering survey);
 - 26) Formwork and shoring erection and removal;
 - 27) Precast Concrete.
- C. Submit the APP to the COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.
- D. Once accepted by the COR, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.
- E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the COR. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34) and the environment.

1.5 ACTIVITY HAZARD ANALYSES (AHAS):

- A. AHAs are also known as Job Hazard Analyses, Job Safety Analyses, and Activity Safety Analyses. Before beginning each work activity involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or sub-contractor is to perform the work, the Contractor(s) performing that work activity shall prepare an AHA (Example electronic AHA forms can be found on the US Army Corps of Engineers web site)
- B. AHAs shall define the activities being performed and identify the work sequences, the specific anticipated hazards, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk.
- C. Work shall not begin until the AHA for the work activity has been accepted by the COR and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as

specified by OSHA and/or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.

2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).
 - a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.
 - b. If a new Competent/Qualified Person (not on the original list) is added, the list shall be updated (an administrative action not requiring an updated AHA). The new person shall acknowledge in writing that he or she has reviewed the AHA and is familiar with current site safety issues.
3. Submit AHAs to the COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.
4. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.
5. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. All activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier, or subcontractor and provided to the prime contractor for review and approval and then submitted to the COR.

1.6 PRECONSTRUCTION CONFERENCE:

- A. Contractor representatives who have a responsibility or significant role in implementation of the accident prevention program, as required by 29 CFR 1926.20(b)(1), on the project shall attend the preconstruction conference to gain a mutual understanding of its implementation. This includes the project superintendent, subcontractor superintendents, and any other assigned safety and health professionals.
- B. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.
- C. Deficiencies in the submitted APP will be brought to the attention of the Contractor within 14 days of submittal, and the Contractor shall revise the plan to correct

deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

1.7 "SITE SAFETY AND HEALTH OFFICER" (SSHO) AND "COMPETENT PERSON" (CP):

- A. The Prime Contractor shall designate a minimum of one SSHO at each project site that will be identified as the SSHO to administer the Contractor's safety program and government-accepted Accident Prevention Plan. Each subcontractor shall designate a minimum of one CP in compliance with 29 CFR 1926.20 (b)(2) that will be identified as a CP to administer their individual safety programs.
- B. Further, all specialized Competent Persons for the work crews will be supplied by the respective contractor as required by 29 CFR 1926 (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).
- C. These Competent Persons can have collateral duties as the subcontractor's superintendent and/or work crew lead persons as well as fill more than one specialized CP role (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).
- D. The SSHO or an equally-qualified Designated Representative/alternate will maintain a presence on the site during construction operations in accordance with FAR Clause 52.236-6: *Superintendence by the Contractor*. CPs will maintain presence during their construction activities in accordance with above mentioned clause. A listing of the designated SSHO and all known CPs shall be submitted prior to the start of work as part of the APP with the training documentation and/or AHA as listed in Section 1.8 below.
- E. The repeated presence of uncontrolled hazards during a contractor's work operations will result in the designated CP as being deemed incompetent and result in the required removal of the employee in accordance with FAR Clause 52.236-5: Material and Workmanship, Paragraph (c).

1.8 TRAINING:

- A. The designated Prime Contractor SSHO must meet the requirements of all applicable OSHA standards and be capable (through training, experience, and qualifications) of ensuring that the requirements of 29 CFR 1926.16 and other appropriate Federal, State and local requirements are met for the project. As a minimum the SSHO must have completed the OSHA 30-hour Construction Safety class and have five (5) years of construction industry safety experience or three (3) years if he/she possesses a Certified Safety Professional (CSP) or certified Construction Safety and Health Technician (CSHT) certification or have a safety and health degree from an accredited university or college.
- B. All designated CPs shall have completed the OSHA 30-hour Construction Safety course within the past 5 years.
- C. In addition to the OSHA 30 Hour Construction Safety Course, all CPs with high hazard work operations such as operations involving asbestos, electrical, cranes, demolition, work at heights/fall protection, fire safety/life safety, ladder, rigging, scaffolds, and trenches/excavations shall have a specialized formal course in the hazard recognition & control associated with those high hazard work operations. Documented "repeat"

deficiencies in the execution of safety requirements will require retaking the requisite formal course.

- D. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course and any necessary safety training to be able to identify hazards within their work environment.
- E. Submit training records associated with the above training requirements to the COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance.
- F. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the SSHO or his/her designated representative. As a minimum, this briefing shall include information on the site-specific hazards, construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, emergency procedures, accident reporting etc... Documentation shall be provided to the COR that individuals have undergone contractor's safety briefing.
- G. Ongoing safety training will be accomplished in the form of weekly documented safety meeting.

1.9 INSPECTIONS:

- A. The SSHO shall conduct frequent and regular safety inspections (daily) of the site and each of the subcontractors CPs shall conduct frequent and regular safety inspections (daily) of their work operations as required by 29 CFR 1926.20(b)(2). Each week, the SSHO shall conduct a formal documented inspection of the entire construction areas with the subcontractors' "Trade Safety and Health CPs" present in their work areas. Coordinate with, and report findings and corrective actions weekly to the COR.
- B. A Certified Safety Professional (CSP) with specialized knowledge in construction safety or a certified Construction Safety and Health Technician (CSHT) shall randomly conduct a monthly site safety inspection. The CSP or CSHT can be a corporate safety professional or independently contracted. The CSP or CSHT will provide their certificate number on the required report for verification as necessary.
 - 1. Results of the inspection will be documented with tracking of the identified hazards to abatement.
 - 2. The COR will be notified immediately prior to start of the inspection and invited to accompany the inspection.
 - 3. Identified hazard and controls will be discussed to come to a mutual understanding to ensure abatement and prevent future reoccurrence.
 - 4. A report of the inspection findings with status of abatement will be provided to the COR within one week of the onsite inspection.

1.10 ACCIDENTS, OSHA 300 LOGS, AND MAN-HOURS:

- A. Notify the COR as soon as practical, but no more than four hours after any accident meeting the definition of OSHA Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$5,000, or any weight handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and

time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the COR determine whether a government investigation will be conducted.

- B. Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, and property damage accidents resulting in at least \$20,000 in damages, to establish the root cause(s) of the accident. Complete the VA Form 2162, and provide the report to the COR within 5 calendar days of the accident. The COR will provide copies of any required or special forms.
- C. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to the COR monthly.
- D. A summation of all OSHA recordable accidents experienced on site by the contractor and associated sub-contractors for each month will be provided to the COR monthly. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the COR as requested.

1.11 PERSONAL PROTECTIVE EQUIPMENT (PPE):

- A. PPE is governed in all areas by the nature of the work the employee is performing. For example, specific PPE required for performing work on electrical equipment is identified in NFPA 70E, Standard for Electrical Safety in the Workplace.
- B. Mandatory PPE includes:
 - 1. Hard Hats – unless written authorization is given by the COR in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA regulations.
 - 2. Safety glasses - unless written authorization is given by the COR appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.
 - 3. Appropriate Safety Shoes – based on the hazards present, safety shoes meeting the requirements of ASTM F2413-11 shall be worn by each person on site unless written authorization is given by the COR.
 - 4. Hearing protection - Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks.

1.12 INFECTION CONTROL

- A. Infection Control is critical in all medical center facilities. Interior construction activities causing disturbance of existing dust, or creating new dust, must be conducted within ventilation-controlled areas that minimize the flow of airborne particles into patient areas. Exterior construction activities causing disturbance of soil or creates dust in some other manner must be controlled.
- B. An AHA associated with infection control will be performed by VA personnel in accordance with FGI Guidelines (i.e. Infection Control Risk Assessment (ICRA)). The ICRA procedure found on the American Society for Healthcare Engineering (ASHE)

website will be utilized. Risk classifications of Class II or lower will require approval by the COR before beginning any construction work. Risk classifications of Class III or higher will require a permit before beginning any construction work. Infection Control permits will be issued by the COR. The Infection Control Permits will be posted outside the appropriate construction area. More than one permit may be issued for a construction project if the work is located in separate areas requiring separate classes. The primary project scope area for this project is: **Class II**, however, work outside the primary project scope area may vary. The required infection control precautions with each class are as follows:

1. Class II requirements:
 - a. During Construction Work:
 - 1) Notify the COR.
 - 2) Provide active means to prevent airborne dust from dispersing into atmosphere such as wet methods or tool mounted dust collectors where possible.
 - 3) Water mist work surfaces to control dust while cutting.
 - 4) Seal unused doors with duct tape.
 - 5) Block off and seal air vents.
 - 6) Remove or isolate HVAC system in areas where work is being performed.
 - b. Upon Completion:
 - 1) Wipe work surfaces with cleaner/disinfectant.
 - 2) Contain construction waste before transport in tightly covered containers.
 - 3) Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.
 - 4) Upon completion, restore HVAC system where work was performed
 - 5) Notify the COR.

C. Products and Materials:

1. Sheet Plastic: Fire retardant polystyrene, 6-mil thickness meeting local fire codes
2. Dust proof one-hour drywall
3. High Efficiency Particulate Air-Equipped filtration machine rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Maintenance of equipment and replacement of the HEPA filters and other filters will be in accordance with manufacturer's instructions.
4. Exhaust Hoses: Heavy duty, flexible steel reinforced; Ventilation Blower Hose
5. Adhesive Walk-off Mats: Provide minimum size mats of 24 inches x 36 inches

6. Disinfectant: Hospital-approved disinfectant or equivalent product
 7. Portable Ceiling Access Module
- D. Before any construction on site begins, all contractor personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.
- E. A dust control program will be establish and maintained as part of the contractor's infection preventive measures in accordance with the FGI Guidelines for Design and Construction of Healthcare Facilities. Prior to start of work, prepare a plan detailing project-specific dust protection measures with associated product data, including periodic status reports, and submit to COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- F. Medical center Infection Control personnel will monitor for airborne disease (e.g. aspergillosis) during construction. A baseline of conditions will 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 with safe thresholds established.
- G. In general, the following preventive measures shall be adopted during construction to keep down dust and prevent mold.
1. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. HEPA filtration is required where the exhaust dust may reenter the medical center.
 2. Exhaust hoses shall be exhausted so that dust is not reintroduced to the medical center.
 3. 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 it is created. Transport these outside the construction area in containers with tightly fitting lids.
 4. 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.
 5. 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.
 6. 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.

H. 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.

I. Exterior Construction

1. Contractor shall verify that dust will not be introduced into the medical center through intake vents, or building openings. HEPA filtration on intake vents is required where dust may be introduced.
2. Dust created from disturbance of soil such as from vehicle movement will be wetted with use of a water truck as necessary
3. All cutting, drilling, grinding, sanding, or disturbance of materials shall be accomplished with tools equipped with either local exhaust ventilation (i.e. vacuum systems) or wet suppression controls.

1.13 TUBERCULOSIS SCREENING

A. Contractor shall provide written certification that all contract employees assigned to the work site have had a pre-placement tuberculin screening within 90 days prior to assignment to the worksite and been found have negative TB screening reactions. Contractors shall be required to show documentation of negative TB screening reactions for any additional workers who are added after the 90-day requirement before they will be allowed to work on the work site. NOTE: This can be the Center for Disease Control (CDC) and Prevention and two-step skin testing or a Food and Drug Administration (FDA)-approved blood test.

1. Contract employees manifesting positive screening reactions to the tuberculin shall be examined according to current CDC guidelines prior to working on VHA property.
2. Subsequently, if the employee is found without evidence of active (infectious) pulmonary TB, a statement documenting examination by a physician shall be on file with the employer (construction contractor), noting that the employee with a positive tuberculin screening test is without evidence of active (infectious) pulmonary TB.
3. If the employee is found with evidence of active (infectious) pulmonary TB, the employee shall require treatment with a subsequent statement to the fact on file with the employer before being allowed to return to work on VHA property.

1.14 FIRE SAFETY

A. Fire Safety Plan: Establish and maintain a site-specific fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. This plan may be an element of the Accident Prevention Plan.

- B. 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.
- C. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings 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).
- D. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with COR.
- E. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to COR.
- F. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- G. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- H. 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.
- I. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with COR.
- J. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR at least 24 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- K. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR.
- L. 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.
- M. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- N. 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.

1.15 ELECTRICAL

- A. All electrical work shall comply with NFPA 70 (NEC), NFPA 70B, NFPA 70E, 29 CFR Part 1910 Subpart J – General Environmental Controls, 29 CFR Part 1910 Subpart S

- Electrical, and 29 CFR 1926 Subpart K in addition to other references required by contract.
- B. All qualified persons performing electrical work under this contract shall be licensed journeyman or master electricians. All apprentice electricians performing under this contract shall be deemed unqualified persons unless they are working under the immediate supervision of a licensed electrician or master electrician.
- C. All electrical work will be accomplished de-energized and in the Electrically Safe Work Condition (refer to NFPA 70E for Work Involving Electrical Hazards, including Exemptions to Work Permit). Any Contractor, subcontractor or temporary worker who fails to fully comply with this requirement is subject to immediate termination in accordance with FAR clause 52.236-5(c). Only in rare circumstance where achieving an electrically safe work condition prior to beginning work would increase or cause additional hazards, or is infeasible due to equipment design or operational limitations is energized work permitted. The COR with approval of the Medical Center Director will make the determination if the circumstances would meet the exception outlined above. An AHA specific to energized work activities will be developed, reviewed, and accepted prior to the start of that work.
 1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.
 2. Verification of the absence of voltage after de-energization and lockout/tagout is considered “energized electrical work” (live work) under NFPA 70E, and shall only be performed by qualified persons wearing appropriate shock protective (voltage rated) gloves and arc rate personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.
 3. Personal Protective Equipment (PPE) and electrical testing instruments will be readily available for inspection by the COR.
- D. Before beginning any electrical work, an Activity Hazard Analysis (AHA) will be conducted to include Shock Hazard and Arc Flash Hazard analyses (NFPA Tables can be used only as a last alternative and it is strongly suggested a full Arc Flash Hazard Analyses be conducted). Work shall not begin until the AHA for the work activity has been accepted by the COR and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
- E. Ground-fault circuit interrupters. All 120-volt, single-phase 15- and 20-ampere receptacle outlets on construction sites shall have approved ground-fault circuit interrupters for personnel protection. “Assured Equipment Grounding Conductor Program” only is not allowed.

1.16 FALL PROTECTION

- A. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) for ALL WORK, unless specified differently or the OSHA 29 CFR 1926 requirements are more

stringent, to include steel erection activities, systems-engineered activities (prefabricated) metal buildings, residential (wood) construction and scaffolding work.

1. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.
2. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.
3. A Warning Line System (WLS) may ONLY be used on floors or flat or low-sloped roofs (between 0 - 18.4 degrees or 4:12 slope) and shall be erected around all sides of the work area (See 29 CFR 1926.502(f) for construction of WLS requirements). Working within the WLS does not require FP. No worker shall be allowed in the area between the roof or floor edge and the WLS without FP. FP is required when working outside the WLS.
4. Fall protection while using a ladder will be governed by the OSHA requirements.

1.17 SCAFFOLDS AND OTHER WORK PLATFORMS

- A. All scaffolds and other work platforms construction activities shall comply with 29 CFR 1926 Subpart L.
- B. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) as stated in Section 1.16.
- C. The following hierarchy and prohibitions shall be followed in selecting appropriate work platforms.
 1. Scaffolds, platforms, or temporary floors shall be provided for all work except that can be performed safely from the ground or similar footing.
 2. Ladders less than 20 feet may be used as work platforms only when use of small hand tools or handling of light material is involved.
 3. Ladder jacks, lean-to, and prop-scaffolds are prohibited.
 4. Emergency descent devices shall not be used as working platforms.
- D. Contractors shall use a scaffold tagging system in which all scaffolds are tagged by the Competent Person. Tags shall be color-coded: green indicates the scaffold has been inspected and is safe to use; red indicates the scaffold is unsafe to use. Tags shall be readily visible, made of materials that will withstand the environment in which they are used, be legible and shall include:
 1. The Competent Person's name and signature;
 2. Dates of initial and last inspections.
- E. Mast Climbing work platforms: When access ladders, including masts designed as ladders, exceed 20 ft (6 m) in height, positive fall protection shall be used.

1.18 EXCAVATION AND TRENCHES

- A. All excavation and trenching work shall comply with 29 CFR 1926 Subpart P.
- B. All excavations and trenches 5 feet in depth or greater shall require a written trenching and excavation permit (NOTE – some States and other local jurisdictions require separate state/jurisdiction-issued excavation permits). The permit shall be completed and provided to the COR prior to commencing work for the day. At the end of the day,

the permit shall be closed out and provided to the COR. The permit shall be maintained onsite and include the following:

1. Determination of soil classification
 2. Indication that utilities have been located and identified. If utilities could not be located after all reasonable attempt, then excavating operations will proceed cautiously.
 3. Indication of selected excavation protective system.
 4. Indication that the spoil pile will be stored at least 2 feet from the edge of the excavation and safe access provided within 25 feet of the workers.
 5. Indication of assessment for a potential toxic, explosive, or oxygen deficient atmosphere.
- C. If not using an engineered protective system such as a trench box, shielding, shoring, or other Professional Engineer designed system and using a sloping or benching system, soil classification cannot be Solid Rock or Type A. All soil will be classified as Type B or Type C and sloped or benched in accordance with Appendix B of 29 CFR 1926.

1.19 CRANES

- A. All crane work shall comply with 29 CFR 1926 Subpart CC.
- B. Prior to operating a crane, the operator must be licensed, qualified or certified to operate the crane. Thus, all the provisions contained with Subpart CC are effective and there is no "Phase In" date of November 10, 2014.
- C. A detailed lift permit shall be submitted 14 days prior to the scheduled lift complete with route for truck carrying load, crane load analysis, siting of crane and path of swing. The lift will not be allowed without approval of this document.
- D. Crane operators shall not carry loads
 1. over the general public or VAMC personnel
 2. over any occupied building unless
 - a. the top two floors are vacated
 - b. or overhead protection with a design live load of 300 psf is provided

1.20 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

All installation, maintenance, and servicing of equipment or machinery shall comply with 29 CFR 1910.147 except for specifically referenced operations in 29 CFR 1926 such as concrete & masonry equipment [1926.702(j)], heavy machinery & equipment [1926.600(a)(3)(i)], and process safety management of highly hazardous chemicals (1926.64). Control of hazardous electrical energy during the installation, maintenance, or servicing of electrical equipment shall comply with Section 1.15 to include NFPA 70E and other VA specific requirements discussed in the section.

1.21 CONFINED SPACE ENTRY

- A. All confined space entry shall comply with 29 CFR 1910.146 except for specifically referenced operations in 29 CFR 1926 such as excavations/trenches [1926.651(g)].

- B. A site-specific Confined Space Entry Plan (including permitting process) shall be developed and submitted to the COR.

1.22 WELDING AND CUTTING

As specified in section titled Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR. Obtain permits from COR at least 24 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

1.23 LADDERS

- A. All Ladder use shall comply with 29 CFR 1926 Subpart X.
- B. All portable ladders shall be of sufficient length and shall be placed so that workers will not stretch or assume a hazardous position.
- C. Manufacturer safety labels shall be in place on ladders
- D. Step Ladders shall not be used in the closed position
- E. Top steps or cap of step ladders shall not be used as a step
- F. Portable ladders, used as temporary access, shall extend at least 3 ft (0.9 m) above the upper landing surface.
 - 1. When a 3 ft (0.9-m) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist workers in mounting and dismounting the ladder.
 - 2. In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.
- G. Ladders shall be inspected for visible defects on a daily basis and after any occurrence that could affect their safe use. Broken or damaged ladders shall be immediately tagged "DO NOT USE," or with similar wording, and withdrawn from service until restored to a condition meeting their original design.

1.24 FLOOR & WALL OPENINGS

- A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M.
- B. Floor and roof holes/openings are any that measure over 2 in (51 mm) in any direction of a walking/working surface which persons may trip or fall into or where objects may fall to the level below. See 21.F for covering and labeling requirements. Skylights located in floors or roofs are considered floor or roof hole/openings.
- C. All floor, roof openings or hole into which a person can accidentally walk or fall through shall be guarded either by a railing system with toeboards along all exposed sides or a load-bearing cover. When the cover is not in place, the opening or hole shall be protected by a removable guardrail system or shall be attended when the guarding system has been removed, or other fall protection system.
 - 1. Covers shall be capable of supporting, without failure, at least twice the weight of the worker, equipment and material combined.
 - 2. Covers shall be secured when installed, clearly marked with the word "HOLE", "COVER" or "Danger, Roof Opening-Do Not Remove" or color-coded or equivalent methods (e.g., red or orange "X"). Workers must be made aware of the meaning for color coding and equivalent methods.

3. Roofing material, such as roofing membrane, insulation or felts, covering or partly covering openings or holes, shall be immediately cut out. No hole or opening shall be left unattended unless covered.
4. Non-load-bearing skylights shall be guarded by a load-bearing skylight screen, cover, or railing system along all exposed sides.
5. Workers are prohibited from standing/walking on skylights.

-- End of Section --

SECTION 01 45 29 TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies materials testing activities and inspection services required during project construction for the contractor to self-perform. The contractor, upon award, will submit a Testing and Inspection Plan for VA review and approval. The contractor shall provide all submittal requirements, written and verbal, to the COR.

1.2 APPLICABLE PUBLICATIONS:

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

A. American 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
T205-86	Standard Method Of Test For Density Of Soil In-Place By The Rubber-Balloon Method ASTM D2167-66 R1984

T230-68 Standard Specification For Determining Degree Of Pavement Compaction Of Bituminous Aggregate Mixtures Eighteenth Edition

T238-97 Standard Method Of Test For Density Of Soil And Soil-Aggregate In-Place By Nuclear Methods Shallow Depth Hm-22; Part Ia; Discontinued

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

A370-12 Standard Test Methods and Definitions for Mechanical Testing of Steel Products

A880-95 Standard Practice for Criteria for Use in Evaluation of Testing Laboratories and Organizations for Examination and Inspection of Steel, Stainless Steel, and Related Alloys (Withdrawn 2004)

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

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 (56,000 ft lbf/ft³ (2,700 KNm/m³))

D2167-08)	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2974-07a	Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
D3666-11	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
D6938-10	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
E329-11c	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
E543-09	Standard Specification for Agencies Performing Non-Destructive Testing

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 COR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of COR to such failure.
- C. Written Reports: Testing laboratory shall submit test reports to COR, Contractor, unless other arrangements are agreed to in writing by the COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to COR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK:

- A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:
1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
 2. Provide full time observation of fill placement and compaction and field density testing in trench areas and provide full time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
 3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.
- B. Testing Compaction:
1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with AASHTO T99/T180, Method A, ASTM D698, ASTM D1557, Method A, ASTM D698 and/or ASTM D1557.
 2. Make field density tests in accordance with the primary testing method following ASTM D6938, AASHTO T238 wherever possible. Field density tests utilizing ASTM D1556 AASHTO T191, or ASTM D2167 shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the COR before the tests are conducted.
 - a. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
 - b. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
 - c. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.

- C. Fill and Backfill Material Gradation: One test per number of cubic meters as determined by COR, stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C136, ASTM D422, ASTM D1140.
- D. Testing Materials: Test suitability of on-site and off-site borrow as directed by COR.

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 COR.

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. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.
 - 3. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with AASHTO T191, ASTM D1556.
- 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 TYPE OF TEST:

Approximate number of tests required to be approved by the COR.

A. Earthwork:

1. Laboratory Compaction Test, Soils: Develop standard Proctor for each type of fill, backfill, and subgrade material used (ASTM D698).
2. Field density test of subgrade using ASTM D6938 (nuclear gauge) on the following frequencies:
 - a. Under Paved Areas: One (1) test per 400 SY, or as required by the Contracting Officer' representative. Four (4) tests anticipated
 - b. Curb, Gutter, and Sidewalk: One (1) test per 300 LF, but no fewer than two (2). Two (2) tests anticipated.
 - c. Trenches: One (1) test per 100 LF per 4 feet lift; twelve (12) tests anticipated.

B. Aggregate Base Course Compaction:

1. Develop Modified Proctor for each base course material used.
2. Field density test of base course using ASTM D6938: Three (3) tests per day's placement.
3. Aggregate Gradation and Quality Test: One (1) per source.

C. Asphalt Concrete:

1. Aggregate Quality: Included in mix design.
2. Mix Temperature: Throughout placement.
3. Mat Density: Two (2) per day's placement.

D. Portland Cement Concrete:

1. Three (3) cylinders collected for each fifty (50) CY placed, and no less than three (3) per day.
2. Slump Test: First load of the day and each time cylinders are collected.
3. Air Content: First load of the day and every twenty-five (25) CY thereafter.
4. Compressive Strength Testing: On all cylinders collected.

-- End of Section --

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. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
 - 2. Sediment: Soil and other debris that has been eroded and transported by runoff water.
 - 3. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
 - 4. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.

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 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 COR 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 COR 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. Description of the Contractor's environmental protection personnel training program.
 - d. 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.
 - e. 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.
 - f. 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.
 - g. Permits, licenses, and the location of the solid waste disposal area.
 - h. 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.
 - i. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - j. 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.

1.4 PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.
- 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 COR. 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 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 required. 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. Reuse or conserve the collected topsoil sediment as directed by the COR. Topsoil use and requirements are specified in Section 31 20 11, EARTH MOVING (Short Form).
 - b. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and permanent erosion and sedimentation control features on the Environmental Protection Plan. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.
 6. Manage borrow areas on Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.
 7. Manage and control spoil areas on Government property to limit spoil to areas on the Environmental Protection Plan and prevent erosion of soil or sediment from entering nearby water courses or lakes.
 8. Protect adjacent areas from despoilment by temporary excavations and embankments.
 9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
 10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 11. Handle discarded materials other than those included in the solid waste category as directed by the COR.
- C. 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 Colorado and State Air Pollution Statute, Rule, or Regulation 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.
- D. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
1. Perform construction activities involving repetitive, high-level impact noise only between 8:00 a.m. and 6:00 p.m. unless otherwise permitted by local ordinance or the COR. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75
- E. 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.
- F. 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 COR. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

-- End of Section --

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. Green waste (biodegradable landscaping materials).
 - 3. Metal products (eg, steel, wire, beverage containers, copper, etc).
 - 4. Cardboard, paper and packaging.
 - 5. Plastics (eg, ABS, PVC).
 - 6. Insulation.
 - 7. Paint.

1.2 QUALITY ASSURANCE

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction/Demolition waste includes products of the following:

1. Excess or unusable construction materials.
 2. Packaging used for construction products.
 3. Poor planning and/or layout.
 4. Construction error.
 5. Over ordering.
 6. Weather damage.
 7. Contamination.
 8. Mishandling.
 9. Breakage.
- B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.
- C. Contractor shall develop and implement procedures to recycle construction and demolition waste to a minimum of 50 percent.
- D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.
- E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website <http://www.wbdg.org/tools/cwm.php> provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.
- F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.
- G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.
- H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

1.3 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.

1.4 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.

1.5 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. U.S. Green Building Council (USGBC):
LEED Green Building Rating System for New Construction

1.6 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.

-- End of Section --

SECTION 01 81 11

SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 OBJECTIVES

A. To maximize resource efficiency and reduce the environmental impacts of construction and operation, the Contractor during the construction phase of this project shall implement the following procedures:

1. Select products that minimize consumption of energy, water and non-renewable resources, while minimizing the amounts of pollution resulting from the production and employment of building technologies. It is the intent of this project to conform with EPA's Five Guiding Principles on environmentally preferable purchasing. The five principles are:
 - a. Include environmental considerations as part of the normal purchasing process.
 - b. Emphasize pollution prevention early in the purchasing process.
 - c. Examine multiple environmental attributes throughout a product's or service's life cycle.
 - d. Compare relevant environmental impacts when selecting products and services.
 - e. Collect and base purchasing decisions on accurate and meaningful information about environmental performance.
2. Control sources for potential Indoor Air Quality (IAQ) pollutants by controlled selection of materials and processes used in project construction in order to attain superior IAQ.
3. Products and processes that achieve the above objectives to the extent currently possible and practical have been selected and included in these Construction Documents. The Contractor is responsible to maintain and support these objectives in developing means and methods for performing the work of this Contract and in proposing product substitutions and/or changes to specified processes.
4. Use building practices that insure construction debris and particulates do not contaminate or enter duct work prior to system startup and turn over.

1.3 RELATED DOCUMENTS

- A. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- B. Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.

1.4 DEFINITIONS

- A. Agrifiber Products: Composite panel products derived from agricultural fiber.
- B. Biobased Product: As defined in the 2002 Farm Bill, a product determined by the Secretary to be a commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials.
- C. Biobased Content: The weight of the biobased material divided by the total weight of the product and expressed as a percentage by weight.
- D. Certificates of Chain-of-Custody: Certificates signed by manufacturers certifying that wood used to make products has been tracked through its extraction and fabrication to ensure that it was obtained from forests certified by a specified certification program.
- E. Composite Wood: A product consisting of wood fiber or other plant particles bonded together by a resin or binder.
- F. Construction and Demolition Waste: Includes solid wastes, such as building materials, packaging, rubbish, debris, and rubble resulting from construction, remodeling, repair and demolition operations. A construction waste management plan is to be provided by the Contractor as defined in Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- G. Third Party Certification: Certification of levels of environmental achievement by nationally recognized sustainability rating system.
- H. Light Pollution: Light that extends beyond its source such that the additional light is wasted in an unwanted area or in an area where it inhibits view of the night sky.
- I. Recycled Content Materials: Products that contain pre-consumer or post-consumer materials as all or part of their feedstock.
- J. Post-Consumer Recycled Content: The percentage by weight of constituent materials that have been recovered or otherwise diverted from the solid-waste stream after consumer use.
- K. Pre-Consumer Recycled Content: Materials that have been recovered or otherwise diverted from the solid-waste stream during the manufacturing process. Pre-consumer content must be material that would not have otherwise entered the waste stream as per Section 5 of the FTC Act, Part 260 "Guidelines for the Use of Environmental Marketing Claims": www.ftc.gov/bcp/gmrule/guides980427
- L. Regional Materials: Materials that are extracted, harvested, recovered, and manufactured within a radius of 250 miles (400 km) from the Project site.
- M. Salvaged or Reused Materials: Materials extracted from existing buildings in order to be reused in other buildings without being manufactured.
- N. Sealant: Any material that fills and seals gaps between other materials.
- O. Type 1 Finishes: Materials and finishes which have a potential for short-term levels of off gassing from chemicals inherent in their manufacturing process, or which are applied in a form requiring vehicles or carriers for spreading which release a high level of particulate matter in the process of installation and/or curing.

- P. Type 2 Finishes: "Fuzzy" materials and finishes which are woven, fibrous, or porous in nature and tend to adsorb chemicals offgas.
- Q. Volatile Organic Compounds (VOCs): Any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. Compounds that have negligible photochemical reactivity, listed in EPA 40 CFR 51.100(s), are also excluded from this regulatory definition.

1.5 SUBMITTALS

A. Sustainable Design Submittals:

1. Heat Island Effect, Site Paving: Provide manufacturer's cut sheets for all impervious paving materials, highlighting the Solar Reflectance Index (SRI) of the material. Also, provide cut sheets for all pervious paving materials.
2. Irrigation Systems: Provide manufacturer's cut sheets for all permanent landscape irrigation system components and for any rainwater harvesting system components, such as cisterns.
3. On-Site Renewable Energy Systems: Provide cut sheets and manufacturer's product data for all on-site renewable energy generating components and equipment, including documentation of output capacity.
4. Measurement and Verification Systems: Provide cut sheets and manufacturer's product data for all controls systems, highlighting electrical metering and trending capability components.
5. Salvaged or Reused Materials: Provide documentation that lists each salvaged or reused material, the source or vendor of the material, the purchase price, and the replacement cost if greater than the purchase price.
6. Recycled Content: Submittals for all materials with recycled content (excluding MEP systems equipment and components) must include the following documentation: Manufacturer's product data, product literature, or a letter from the manufacturer verifying the percentage of post-consumer and pre-consumer recycled content (by weight) of each material or product
 - a. An electronic spreadsheet that tabulates the Project's total materials cost and combined recycled content value (defined as the sum of the post-consumer recycled content value plus one-half of the pre-consumer recycled content value) expressed as a percentage of total materials cost. This spreadsheet shall be submitted every third month with the Contractor's Certificate and Application for Payment. It should indicate, on an ongoing basis, line items for each material, including cost, pre-consumer recycled content, post-consumer recycled content, and combined recycled content value.
7. Interior Adhesives and Sealants: Submittals for all field-applied adhesives and sealants, which have a potential impact on indoor air, must include manufacturer's MSDSs or other Product Data highlighting VOC content.
 - a. Provide manufacturers' documentation verifying all adhesives used to apply laminates, whether shop-applied or field-applied, contain no urea-formaldehyde.

8. Interior Paints and Coatings: Submittals for all field-applied paints and coatings, which have a potential impact on indoor air, must include manufacturer's MSDSs or other Product Data highlighting VOC content
 9. Exterior Paints and Coatings: Submittals for all field-applied paints and coatings, which have a potential impact on ambient air quality, must include manufacturer's MSDSs or other manufacturer's Product Data highlighting VOC content.
 10. Blended Cement: It is the intent of this specification to reduce CO2 emissions and other environmentally detrimental effects resulting from the production of portland cement by requiring that all concrete mixes, in aggregate, utilize blended cement mixes to displace portland cement as specified in Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE typically included in conventional construction. Provide the following submittals:
 - a. Copies of concrete design mixes for all installed concrete
 - b. Copies of typical regional baseline concrete design mixes for all compressive strengths used on the Project
 - c. Quantities in cubic yards of each installed concrete mix
 11. Fiberglass Insulation: Provide manufacturer's cut sheets or product data verifying that fiberglass batt insulation contains no urea-formaldehyde.
- B. Project Materials Cost Data: Provide a spreadsheet in an electronic file indicating the total cost for the Project and the total cost of building materials used for the Project, as follows:
1. Not more than 60 days after the Preconstruction Meeting, the General Contractor shall provide to the Owner and Architect a preliminary schedule of materials costs for all materials used for the Project organized by specification section. Exclude labor costs and all mechanical, electrical, and plumbing (MEP) systems materials and labor costs. Include the following:
 - a. Identify each reused or salvaged material, its cost, and its replacement value.
 - b. Identify each recycled-content material, its post-consumer and pre-consumer recycled content as a percentage the product's weight, its cost, its combined recycled content value (defined as the sum of the post-consumer recycled content value plus one-half of the pre-consumer recycled content value), and the total combined recycled content value for all materials as a percentage of total materials costs.
 - c. Identify each biobased material, its source, its cost, and the total value of biobased materials as a percentage of total materials costs. Also provide the total value of rapidly renewable materials (materials made from plants that are harvested in less than a 10-year cycle) as a percentage of total materials costs.
 2. Provide final versions of the above spreadsheets to the Owner and Architect not more than 14 days after Substantial Completion.
- C. Construction Waste Management: See Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT for submittal requirements.

- D. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit reports for the following:
 - 1. Construction Waste Management: Waste reduction progress reports and logs complying with the requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
 - 2. Construction IAQ Management: See details below under Section 3.2 Construction Indoor Air Quality Management for Construction IAQ management progress report requirements.

1.6 QUALITY ASSURANCE

- A. Preconstruction Meeting: After award of Contract and prior to the commencement of the Work, schedule and conduct meeting with Owner, Architect, and all Subcontractors to discuss the Construction Waste Management Plan, and all other Sustainable Design Requirements. The purpose of this meeting is to develop a mutual understanding of the Project's Sustainable Design Requirements and coordination of the Contractor's management of these requirements with the Contracting Officer and the Construction Quality Manager.
- B. Construction Job Conferences: The status of compliance with the Sustainable Design Requirements of these specifications will be an agenda item at all regular job meetings conducted during the course of work at the site.

PART 2 - PRODUCTS

2.1 PRODUCT ENVIRONMENTAL REQUIREMENTS

- A. Site Clearing: Topsoil shall be provided by the Contractor from on-site material which has been stockpiled for reuse. Off-site borrow should only be used when on-site sources are exhausted. Chip and/or compost on site all vegetated material identified for removal.
- B. Do not burn rubbish, organic matter, etc. or any material on the site. Dispose of legally in accordance with Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- C. Herbicides and Pest Control: Herbicides shall not be permitted, and pest control measures shall utilize EPA-registered biopesticides only.
- D. Landscape Irrigation: Use water-efficient landscape and irrigation strategies, including water reuse and recycling, to reduce outdoor potable water consumption by a minimum of 50 percent over that consumed by conventional means (plant species and plant densities).
- E. Measurement and Verification: Install controls and monitoring devices as required by MEP divisions order to comply with International Performance Measurement & Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction, April 2003, Option D.
 - 1. The IPMVP provides guidance on situation-appropriate application of measurement and verification strategies.
- F. Salvaged or Reused materials: There shall be no substitutions for specified salvaged and reused materials and products. Use of salvaged materials reduces impacts of disposal and manufacturing of replacements.

G. Recycled Content of Materials:

1. Provide building materials with recycled content such that post-consumer recycled content value plus half the pre-consumer recycled content value constitutes a minimum of 30% of the cost of materials used for the Project, exclusive of all MEP equipment, labor, and delivery costs. The Contractor shall make all attempts to maximize the procurement of materials with recycled content.
 - a. The post-consumer recycled content value of a material shall be determined by dividing the weight of post-consumer recycled content by the total weight of the material and multiplying by the cost of the material.
 - b. Do not include mechanical and electrical components in the calculations.
 - c. Do not include labor and delivery costs in the calculations.
 - d. Recycled content of materials shall be defined according to the Federal Trade Commission’s “Guide for the Use of Environmental Marketing Claims,” 16 CFR 260.7 (e).
 - e. Utilize all on-site existing paving materials that are scheduled for demolition as granulated fill, and include the cost of this material had it been purchased in the calculations for recycled content value.
 - f. The materials in the following list must contain the minimum recycled content indicated:

Category	Minimum Recycled Content
Compost/mulch	100% post-consumer
Asphaltic Concrete Paving	25% post-consumer
Cast-in-Place Concrete	6% pre-consumer
CMU: Gray Block	20% pre-consumer
Aluminum Fabrications	35% combined
Rigid Insulation	20% pre-consumer
Batt insulation	30% combined

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

-- End of Section --

SECTION 02 21 00

SITE SURVEYS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the gathering of research documents, performance of a property and preparation of a site survey map.

1.2 DEFINITIONS

- A. Professional Land Surveyor: One who possesses a valid state license as a "Professional Land Surveyor" from the state in which they practice.
- B. Professional Civil Engineer: One who possesses a valid state license as a "Professional Civil Engineer" from the state in which they practice. For this section, the term "surveyor" shall also include Professional Civil Engineers authorized to practice Land Surveying under the laws of the state in which they practice.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

- A. The survey shall be performed on the ground in accordance with the current "Accuracy Standards for Land Title Surveys" as adopted, from time to time, by the American Congress on Surveying and Mapping, the National Society of Professional Surveyors, and the American Land Title Association.
- B. The surveyor, when applicable, shall consult with the Contracting Officer to determine scale of plat or map and size of drawings.
- C. The surveyor shall furnish two sets of prints of the plat or map of survey and the electronic CADD file for 3D software. The sheets shall be numbered, the total number of sheets indicated and the match lines shall be shown on each sheet.
- D. On the plat or map, the survey boundary shall be drawn to a scale not larger than 1 inch = 30 feet (25 mm = 9 m), with the scale clearly indicated. A graphic scale, shown in feet or meters or both, shall be included. A north arrow shall be shown and when practicable, the plat or map of survey shall be oriented so that north is at the top of the drawing. Symbols or abbreviations used shall be identified on the face of the plat or map by use of a legend or other means. Supplementary or exaggerated diagrams shall be presented accurately on the plat or map where dimensional data is too small to be shown clearly at full scale. The plat or map shall be 30 by 42 inches.
- E. The survey shall contain the following applicable information:
 - 1. Driveways and alleys on or crossing the property must be shown. Where there is evidence of use by other than the occupants of the property, the surveyor must

so indicate on the plat or map. Where driveways or alleys on adjoining properties encroach, in whole or in part, on the property being surveyed, the surveyor must so indicate on the plat or map with appropriate measurements.

2. Location, alignment and dimensions of all roads, curbs, walks, parking and paved areas abutting the subject land. Indicate road centerlines with true bearings and lengths by 50 foot stationing. Describe curves by designating the points of curvature and tangency by station. Include all curve data as well a location of radius and vertex points. Elevations on 50 foot (15 m) centers on centerline of roads, edges of roads and top and bottom of curbs.
3. Parking areas and, if striped, the striping and the type (eg. handicapped, motorcycle, regular, etc.) and number of parking spaces.
4. Indication of access to a public way such as curb cuts and driveways.
5. Location of utilities existing on or serving the surveyed property as determined by observed evidence together with plans and markings provided by utility companies, and other appropriate sources (with references as to the source of information. Locate and show all fire hydrants located within 500 feet of the subject property.
6. Manholes, catch basins, valve vaults or other surface indications of subterranean uses together with depths or invert elevations, sizes, and materials of all pipes.
7. Wires and cables (including their function) crossing the survey premises, all poles on or within ten feet of the surveyed premises, and the dimensions of all cross-wires or overhangs affecting the surveyed premises.
8. Utility company installations on the surveyed premises.
9. Observable evidence of earth moving work, within recent months.
10. Any changes in street right-of-way lines either completed or proposed, and available from the controlling jurisdiction. Observable evidence of recent street or sidewalk construction or repairs.
11. Observable evidence of site use as a solid waste dump, sump or sanitary landfill.
12. All trees with a minimum diameter of 6" measured at 48" above the base of the tree. Perimeter outline only of thickly wooded areas with description of predominant vegetation.

-- End of Section --

SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies demolition and removal of underground steam and condensate piping, existing manholes, other structures and debris.

1.2 RELATED WORK:

- A. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- C. Infectious Control Measures: Section 01 35 26, SAFETY REQUIREMENTS, Article 1.12, INFECTION CONTROL.

1.3 PROTECTION:

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

2. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- F. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center Property; any damaged items shall be repaired or replaced as approved by the COR. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COR approval.
 - G. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
 - H. The work shall comply with the requirements of Section 01 35 26, SAFETY REQUIREMENTS, Article 1.12 INFECTION CONTROL.

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 underground steam and condensate piping and existing manholes, 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 Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COR. 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. Remove and legally dispose of all materials, other than earth to remain as part of project work. 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 1500 mm (5 feet) 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.
- D. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COR. When Utility lines are encountered that are not indicated on the drawings, the COR shall be notified prior to further work in that area.

3.2 CLEAN-UP:

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COR. Clean-up shall include off the Medical Center Property 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.

-- End of Section --

SECTION 03 30 53

(SHORT-FORM) CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 RELATED WORK:

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

1.3 TOLERANCES:

ACI 117.

1.4 REGULATORY REQUIREMENTS:

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

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Concrete Mix Design.
- C. Shop Drawings: Reinforcing steel: Complete shop drawings.
- D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

1.6 APPLICABLE PUBLICATIONS:

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. American Concrete Institute (ACI):
 - 117-10 Specification for Tolerances for Concrete Construction, Materials and Commentary

211.1-91(R2009)	Standard Practice for Proportions for Normal, Heavyweight, and Mass Concrete
211.2-98(R2004)	Standard Practice for Selecting Proportions for Structural Lightweight Concrete
305.1-06	Specification for Hot Weather Concreting
306.1-90(R2002)	Standard Specification for Cold Weather Concreting
SP-66-04	ACI Detailing Manual
318-11	Building Code Requirements for Structural Concrete and Commentary
347-04	Guide to Formwork for Concrete
B. American Society for Testing And Materials (ASTM):	
A185/A185M-07	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement
A615/A615M-09	Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
A996/A996M-09	Standard Specification for Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement
C33/C33M-11a	Standard Specification for Concrete Aggregates
C39/C39M-12	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C94/C94M-12	Standard Specification for Ready Mixed Concrete
C143/C143M-10	Standard Test Method for Slump of Hydraulic Cement Concrete
C150-11	Standard Specification for Portland Cement
C171-07	Standard Specification for Sheet Material for Curing Concrete
C192/C192M-07	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

C260-10	Standard Specification for Air-Entraining Admixtures for Concrete
C330-09	Standard Specification for Lightweight Aggregates for Structural Concrete
C494/C494M-11	Standard Specification for Chemical Admixtures for Concrete
C618-12	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
D1751-04(R2008)	Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
D4397-10	Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications

PART 2 - PRODUCTS

2.1 FORMS:

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

2.2 MATERIALS:

- A. Portland Cement: ASTM C150, Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.
- D. Fine Aggregate: ASTM C33.
- E. Lightweight Aggregate for Structural Concrete: ASTM C330, See tables below.
- F. Mixing Water: Fresh, clean, and potable.
- G. Air-Entraining Admixture: ASTM C260.
- H. Chemical Admixtures: ASTM C494.

- I. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil)//0.38 mm (15 mil).
- J. Reinforcing Steel: ASTM A615 or ASTM A996, deformed.
- K. Welded Wire Fabric: ASTM A185.
- L. Expansion Joint Filler: ASTM D1751.
- M. Sheet Materials for Curing Concrete: ASTM C171.
- N. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- O. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- P. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout shall show no settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement, and produce a compressive strength of at least 18 mpa (2500 psi) at 3 days and 35 mpa (5000 psi) at 28 days.

2.3 CONCRETE MIXES:

- A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days shall be not less than 25 mpa (3000 psi).
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.
- E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

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

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
 2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
 3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
 4. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.
- F. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS. Air content shall conform with the following tables:

TABLE II

TOTAL AIR CONTENT FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)

Nominal Maximum Size of Coarse Aggregate	Total Air Content Percentage by Volume
10 mm (3/8 in)	6 to 10
13 mm (1/2 in)	5 to 9
19 mm (3/4 in)	4 to 8
25 mm (1 in)	3½ to 6½
40 mm (1½ in)	3 to 6

TABLE III

TOTAL AIR CONTENT AIR CONTENT OF LIGHTWEIGHT STRUCTURAL CONCRETE

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

2.4 BATCHING & MIXING:

- A. Store, batch, and mix materials as specified in ASTM C94.
 1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.
 2. Ready-Mixed: Ready-mixed concrete comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed

concrete producer shall furnish, in duplicate, certification as required by ASTM C94.

3. Mixing structural lightweight concrete: Charge mixer with 2/3 of total mixing water and all of the aggregate. Mix ingredients for not less than 30 seconds in a stationary mixer or not less than 10 revolutions at mixing speed in a truck mixer. Add remaining mixing water and other ingredients and continue mixing. Above procedure may be modified as recommended by aggregate producer.

PART 3 - EXECUTION

3.1 FORMWORK:

- A. Installation conform to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.
- B. Treating and Wetting: Treat or wet contact forms as follows:
 1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
 2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather cool metal forms by thoroughly wetting with water just before placing concrete.
 3. Use sealer on reused plywood forms as specified for new material.
- C. Construction Tolerances:
 1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
 2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 REINFORCEMENT:

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

3.3 VAPOR BARRIER:

- A. Except where membrane waterproofing is required, place interior concrete slabs on a continuous vapor barrier.
- B. Place 100 mm (4 inches) of fine granular fill over the vapor barrier to act as a blotter for concrete slab.
- C. Lap joints 150 mm (6 inches) and seal with a compatible pressure-sensitive tape.
- D. Patch punctures and tears.

3.4 PLACING CONCRETE:

- A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of COR before placing concrete. Provide screeds at required elevations for concrete slabs.
- B. Before placing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.
- C. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water or cement more than 1-1/2 hours. Do not allow concrete to drop freely more than 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.
- D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from COR.

3.5 PROTECTION AND CURING:

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

3.6 FORM REMOVAL:

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

3.7 SURFACE PREPARATION:

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

3.8 FINISHES:

A. Vertical and Overhead Surface Finishes:

1. Unfinished Areas: Vertical and overhead concrete surfaces exposed in unfinished areas, above suspended ceilings in manholes, and other unfinished areas exposed or concealed will not require additional finishing.
2. Interior and Exterior Exposed Areas (to be painted): Fins, burrs and similar projections on surface shall be knocked off flush by mechanical means approved by COR and rubbed lightly with a fine abrasive stone or hone. Use an ample amount of water during rubbing without working up a lather of mortar or changing texture of concrete.
3. Interior and Exterior Exposed Areas (finished): Finished areas, unless otherwise shown, shall be given a grout finish of uniform color and shall have a smooth finish treated as follows:
 - a. After concrete has hardened and laitance, fins and burrs have been removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone or stone.
 - b. Apply grout composed of 1 part portland cement and 1 part clean, fine sand (smaller than 600 micro-m (No. 30) sieve). Work grout into surface of concrete with cork floats or fiber brushes until all pits and honeycomb are filled.
 - c. After grout has hardened, but still plastic, remove surplus grout with a sponge rubber float and by rubbing with clean burlap.
 - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish for any area in same day. Confine limits of finished areas to natural breaks in wall surface. Do not leave grout on concrete surface overnight.

3.9 SURFACE TREATMENTS:

- A. Surface treatments shall be mixed and applied in accordance with manufacturer's printed instructions.
- B. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of all concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Aggregate shall be broadcast uniformly over concrete surface. Trowel concrete surface to smooth dense finish. After curing, rub the treated surface with abrasive brick and water sufficiently to slightly expose abrasive aggregate.

3.10 APPLIED TOPPING:

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

3.11 RESURFACING FLOORS:

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

3.12 RETAINING WALLS:

- A. Concrete for retaining walls shall be air-entrained.
- B. Install and construct expansion and contraction joints, waterstops, weep holes, reinforcement and railing sleeves.
- C. Finish exposed surfaces to match adjacent concrete surfaces, new or existing.
- D. Porous backfill shall be placed.

3.13 PRECAST CONCRETE ITEMS:

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

-- End of Section --

SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.1 DESCRIPTION

- A. Closures of openings in walls 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.

1.2 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.

1.3 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.

1.4 WARRANTY

Firestopping work subject to the terms of the Article "Warranty of Construction", FAR clause 52.246-21.

1.5 QUALITY ASSURANCE

FM, UL, or WH or other approved laboratory tested products will be acceptable.

1.6 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. American Society for Testing and Materials (ASTM):
 - E84-07 Surface Burning Characteristics of Building Materials
 - E814-06 Fire Tests of Through-Penetration Fire Stops
- B. Factory Mutual Engineering and Research Corporation (FM):
 - Annual Issue Approval Guide Building Materials
- C. Underwriters Laboratories, Inc. (UL):
 - Annual Issue Building Materials Directory
 - Annual Issue Fire Resistance Directory
 - 1479-03 Fire Tests of Through-Penetration Firestops
- D. 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.

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.

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.

-- End of Section --

SECTION 09 91 00 PAINTING

PART 1-GENERAL

1.1 DESCRIPTION

- A. Section specifies field painting and prime coats which may be applied in shop under other sections.
- B. Painting includes coatings specified, and striping or markers and identity markings.

1.2 RELATED WORK

- A. Sections 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
- C. 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.
- D. Manufacturers' Certificates indicating compliance with specified requirements:
 - 1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
 - 2. High temperature aluminum paint.
 - 3. Epoxy coating.
 - 4. Intumescent clear coating or fire retardant paint.

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°C and 30°C (65°F and 85°F).

1.5 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. American 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) |
- B. American National Standards Institute (ANSI):
- | | |
|----------|-------------------------------------------------|
| A13.1-07 | Scheme for the Identification of Piping Systems |
|----------|-------------------------------------------------|
- C. Commercial Item Description (CID):
- | | |
|----------|------------------------------------------------------------------------|
| A-A-1555 | Water Paint, Powder (Cementitious, White and Colors) (WPC) (cancelled) |
|----------|------------------------------------------------------------------------|

D. Federal Specifications (Fed Spec):

TT-P-1411A Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)

E. Master Painters Institute (MPI):

No. 1-12 Aluminum Paint (AP)

No. 4-12 Interior/ Exterior Latex Block Filler

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. 36-12 Knot Sealer

No. 47-12 Interior Alkyd, Semi-Gloss, MPI Gloss Level 5 (AK)

No. 48-12 Interior Alkyd, Gloss, MPI Gloss Level 6 (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. 77-12 Epoxy Cold Cured, Gloss (EC)

No. 79-12 Marine Alkyd Metal Primer

No. 94-12 Exterior Alkyd, Semi-Gloss (EO)

No. 95-12 Fast Drying Metal Primer

No. 98-12	High Build Epoxy Coating
No. 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

F. 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): Fed. Spec. TT-P-1411A (Paint, Copolymer-Resin, Cementitious (CEP)), Type 1 for exterior use, Type II for interior use.
- B. Plastic Tape: Pressure sensitive adhesive back.
- C. Identity markers options:
 - 1. Pressure sensitive vinyl markers.
 - 2. Snap-on coil plastic markers.
- D. Aluminum Paint (AP): MPI 1.
- E. Interior/Exterior Latex Block Filler: MPI 4.

- F. Exterior Alkyd, Flat (EO): MPI 8.
- G. Exterior Alkyd Enamel (EO): MPI 9.
- H. Exterior Latex, Flat (AE): MPI 10.
- I. Exterior Latex, Semi-Gloss (AE): MPI 11.
- J. Organic Zinc rich Coating (HR): MPI 22.
- K. High Heat Resistant Coating (HR): MPI 22.
- L. Knot Sealer: MPI 36.
- M. Interior Enamel Undercoat: MPI 47.
- N. Interior Alkyd, Semi-Gloss (AK): MPI 47.
- O. Interior Latex Primer Sealer: MPI 50.
- P. Interior Alkyd, Eggshell: MPI 51
- Q. Interior Latex, MPI Gloss Level 3 (LE): MPI 52.
- R. Interior Latex, Flat, MPI Gloss Level 1 (LE): MPI 53.
- S. Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE): MPI 54.
- T. Epoxy Cold Cured, Gloss (EC): MPI 77.
- U. Marine Alkyd Metal primer: MPI 79.
- V. Exterior Alkyd, Semi-Gloss (EO): MPI 94.
- W. Fast Drying Metal Primer: MPI 95.
- X. High Build Epoxy Coating: MPI 98.
- Y. Epoxy Anti-Corrosive Metal Primer: MPI 101.
- Z. High Build Epoxy Marine Coating (EC): MPI 108.
- AA. Interior latex, Gloss (LE) and (LG): MPI 114.
- BB. Exterior Latex, High Gloss (acrylic) (AE): MPI 119.
- CC. Waterborne Galvanized Primer: MPI 134.
- DD. Non-Cementitious Galvanized Primer: MPI 135.
- EE. Interior High Performance Latex, MPI Gloss Level 2(LF): MPI 138.

FF. Interior High Performance Latex, MPI Gloss Level 3 (LL): MPI 139.

GG. Interior High Performance Latex, MPI Gloss Level 4: MPI 140.

HH. 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.

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 ACGIH-DOC confirmed or suspected human carcinogens.

6. 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.

7. Use high performance acrylic paints in place of alkyd paints, where possible.

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°C (5°F) above dew point.
 - b. Below 10°C (50°F) or over 35°C (95°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. See other sections for specified surface conditions and prime coat.

3. 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.
4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.

C. Ferrous Metals:

1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning). Exception: where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
 - a. This includes flat head countersunk screws used for permanent anchors.
 - b. Do not fill screws of item intended for removal such as glazing beads.
4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.

D. Zinc-Coated (Galvanized) Metal Surfaces Specified Painted:

1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion in accordance with SSPC-SP 1 (Solvent Cleaning).
2. Spot coat abraded and damaged areas of zinc-coating which expose base metal on hot-dip zinc-coated items with MPI 18 (Organic Zinc Rich Coating). Prime or spot prime with MPI 134 (Waterborne Galvanized Primer) or MPI 135 (Non-Cementitious Galvanized Primer) depending on finish coat compatibility.

E. Concrete:

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. 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.
4. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in Sections 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE. 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.
- D. Metals except boilers, incinerator stacks, and engine exhaust pipes:
 - 1. Steel and iron: MPI 79 (Marine Alkyd Metal Primer), MPI 95 (Fast Drying Metal Primer). Use MPI 101 (Cold Curing Epoxy Primer) where MPI 77 (Epoxy Cold Cured, Gloss (EC)), MPI 98 (High Build Epoxy Coating), MPI 108 (High Build Epoxy Marine Coating (EC)) finish is specified.
 - 2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer), MPI 135 (Non-Cementitious Galvanized Primer).
 - 3. Terne Metal: MPI 79 (Marine Alkyd Metal Primer), MPI 95 (Fast Drying Metal Primer).
 - 4. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel (EO)).
- E. Concrete Masonry Units except glazed or integrally colored and decorative units:
 - 1. MPI 4 (Block Filler) on interior surfaces.
 - 2. Prime exterior surface as specified for exterior finishes.
- F. Cement Plaster or stucco, Concrete Masonry, Brick Masonry and Cement board Interior Surfaces of Ceilings and Walls:

1. MPI 53 (Interior Latex, Flat, MPI Gloss Level 1 LE), MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)), MPI 114 (Interior Latex, Gloss (LE) and (LG)), except use two coats where substrate has aged less than six months.
2. Use MPI 138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)), MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)), MPI 140 (Interior High Performance latex, MPI Gloss Level 4), MPI 141 (Interior High Performance Latex (SG) MPI Gloss Level 5), MPI 114 (Interior Latex, Gloss (LE) and (LG)), TT-P-1411A (Paint, Copolymer Resin, Cementitious (CEP)) Type II, MPI 77 (Epoxy Cold Cured, Gloss (EC), MPI 98 (High Build Epoxy Coating), MPI 108 (High Build Epoxy Marine Coating (EC)) or CID-A-A-1555 (Water, Paint, Powder) as scheduled.

3.6 EXTERIOR FINISHES

A. Steel and Ferrous Metal, Including Tern:

1. Two coats of MPI 8 (Exterior Alkyd, Flat (EO)), MPI 9 (Exterior Alkyd Enamel (EO)), MPI 94 (Exterior Alkyd, Semi-Gloss (EO)) on exposed surfaces, except on surfaces over 94°C (200°F).
2. One coat of MPI 22 (High Heat Resistant Coating (HR)) on surfaces over 94°C (200°F).

3.7 INTERIOR FINISHES

A. Metal Work:

1. Apply to exposed surfaces.
2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
 - a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) unless specified otherwise.
 - b. Two coats of MPI 48 (Interior Alkyd Gloss (AK)), MPI 51 (Interior Alkyd, Eggshell (AK)).
 - c. Machinery: One coat MPI 9 (Exterior Alkyd Enamel (EO)).

B. Miscellaneous: MPI 1 (Aluminum Paint): Two coats of aluminum paint.

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

3.9 PAINT COAT COLORS

- A. Color of priming coat: Lighter than body coat.
- B. Color of body coat: Lighter than finish coat.
- C. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.

3.10 MECHANICAL AND ELECTRICAL WORK FIELD PAINTING SCHEDULE

- A. Field painting of mechanical and electrical consists of cleaning, touching-up abraded shop prime coats, and applying prime, body and finish coats to materials and equipment if not factory finished in space scheduled to be finished.
- B. Paint various systems specified in Division 02 – EXISTING CONDITIONS, Division 23 – HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL.
- C. Paint after tests have been completed.
- D. Omit prime coat from factory prime-coated items.
- E. Finish painting of mechanical and electrical equipment is not required when located in interstitial spaces, above suspended ceilings, in concealed areas such as pipe and electric closets, pipe basements, pipe tunnels, trenches, attics, roof spaces, shafts and furred spaces except on electrical conduit containing feeders 600 volts or more.

- F. Omit field painting of items specified in paragraph, Building and Structural WORK NOT PAINTED.
- G. Aluminum Color: Ferrous metal on steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).
- H. Apply paint systems on properly prepared and primed surface as follows:
 - 1. Exterior Locations: Apply two coats of MPI 10 (Exterior Latex, Flat (AE)), MPI 11 (Exterior Latex, Semi Gloss (AE)), MPI 119 (Exterior Latex, High Gloss (acrylic) (AE)) to galvanized and zinc-copper alloy metal.
 - 2. Interior Locations:
 - a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) to following items:
 - 1) Metal under 94°C (200°F) of items such as bare piping, fittings, hangers and supports.
 - 2) Equipment and systems such as hinged covers and frames for control cabinets and boxes, cast-iron radiators, electric conduits and panel boards.
 - 3) Plumbing equipment, and machinery having shop prime coat and not factory finished.
 - b. Apply two coats of MPI 22 (High Heat Resistant Coating (HR)) to ferrous metal surface over 94°C (200°F) of following items:
 - 1) Steam line flanges, bare pipe, fittings, valves, hangers and supports over 94°C (200°F).
 - 3. Other exposed locations:
 - a. Metal surfaces, except aluminum, of cooling towers exposed to view, including connected pipes, rails, and ladders: Two coats of MPI 1 (Aluminum Paint (AP)).
 - b. Cloth jackets of insulation of pipes in connection with plumbing, systems: One coat of MPI 50 (Interior Latex Primer Sealer) and one coat of MPI 10 (Exterior Latex, Flat (AE)), MPI 11 (Exterior Latex Semi-Gloss (AE)), MPI 119 (Exterior Latex, High Gloss (acrylic)(AE)).

3.11 BUILDING AND STRUCTURAL WORK FIELD PAINTING

- A. Painting and finishing of interior and exterior work except as specified under paragraph 3.11 B.
 - 1. Painting of ferrous metal and galvanized metal.

2. Painting and finishing of new and existing work including colors and gloss of finish selected.
 3. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
 4. Identity painting and safety painting.
- B. Building and Structural Work not Painted:
1. Finished surfaces:
 - a. Hardware except ferrous metal.
 - b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as otherwise specified.
 2. 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.
 3. Metal safety treads and nosings.
 4. Gaskets.
 5. Concrete curbs, gutters, pavements, retaining walls, exterior exposed foundations walls and interior walls in pipe basements.
 6. Structural steel encased in concrete, masonry, or other enclosure.

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 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.
6. Legend name in full or in abbreviated form as follows:

PIPING	COLOR OF BACKGROUND	COLOR OF LETTERS	LEGEND ABBREVIATIONS
High Pressure Steam	Yellow	Black	HPS
High Pressure Condensate Return	Yellow	Black	HPR
Medium Pressure Steam	Yellow	Black	MPS
Medium Pressure Condensate Return	Yellow	Black	MPR
Low Pressure Steam	Yellow	Black	LPS
Low Pressure Condensate Return	Yellow	Black	LPR
Pumped Return	Yellow	Black	PR
Vacuum Return	Yellow	Black	VR
Pumped Condensate		Black	Pump Condensate
Pump Recirculating	Yellow	Black	Pump-Recirculating
Vent (Inside)	Yellow	Black	Vent

3.13 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.

-- End of Section --

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 equipment so that they remain safe and functional in case of seismic event.
- B. The design to resist seismic load shall be based on Seismic Design Categories per Section 4.0 of the VA Seismic Design Requirements (H-18-8), dated August 2013, <http://www.cfm.va.gov/til/etc/seismic.pdf>.
- C. 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. Electrical Elements: Power and lighting systems; substations; switchgear and switchboards; auxiliary engine-generator sets; transfer switches; motor control centers; motor generators; selector and controller panels; fire protection and alarm systems; special life support systems; and telephone and communication systems.
 - 2. Mechanical Elements: Heating, ventilating, and air-conditioning systems; medical gas systems; plumbing systems; sprinkler systems; pneumatic systems; boiler equipment and components.

1.2 QUALITY CONTROL:

- A. Shop-Drawing Preparation:
 - 1. Have seismic-force-restraint shop drawings and calculations prepared by a professional structural engineer experienced in the area of seismic force restraints. The professional structural engineer shall be registered in the state where the project is located.
 - 2. Submit design tables and information used for the design-force levels, stamped and signed by a professional structural engineer registered in the State where project is located.
- B. Coordination:
 - 1. Do not install seismic restraints until seismic restraint submittals are approved by the 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, 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.

1.3 SUBMITTALS:

- A. Submit a coordinated set of equipment anchorage drawings prior to installation including:
1. Description, layout, and location of items to be anchored or braced with anchorage or brace points noted and dimensioned.
 2. Details of anchorage or bracing at large scale with all members, parts, brackets, together with all connections, bolts, welds etc. clearly identified and specified.
 3. Numerical value of design seismic brace loads.
- 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. Type of pipe (Copper, steel, cast iron, insulated, non-insulated, etc.).
 2. Pipe contents.
 3. Location of all gravity load pipe supports and spacing requirements.
 4. Numerical value of gravity load reactions.
 5. Location of all seismic bracing.
 6. Numerical value of applied seismic brace loads.
 7. Type of connection (Vertical support, vertical support with seismic brace etc.).
 8. 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 design calculations prepared and sealed by the registered structural engineer specified above in paragraph 1.3A.

1.4 APPLICABLE PUBLICATIONS:

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. American Concrete Institute (ACI):
 - 355.2-07 Qualification for Post-Installed Mechanical Anchors in Concrete and Commentary
- B. American Society for Testing and Materials (ASTM):
 - A615/A615M-09 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - A996/A996M-09 Standard Specification for Rail-Steel and Axel-Steel Deformed Bars for Concrete Reinforcement
 - E488-96(R2003) Standard Test Method for Strength of Anchors in Concrete and Masonry Element
- C. American Society of Civil Engineers (ASCE 7) Latest Edition.
- D. International Building Code (IBC) Latest Edition
- E. VA Seismic Design Requirements, H-18-8, August 2013
- F. National Uniform Seismic Installation Guidelines (NUSIG)
- G. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - Seismic Restraint Manual Guidelines for Mechanical Systems, 1998 Edition and Addendum

1.5 REGULATORY REQUIREMENT:

- A. IBC Latest Edition.
- 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. Piping in boiler plants and equipment rooms less than 1¼ inches inside diameter.

3. All other piping less than 2½ inches inside diameter, except for automatic fire suppression systems.
4. 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.
5. All electrical conduits, less than 2½ inches inside diameter.

PART 2 – PRODUCTS

2.1 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 MECHANICAL PIPING; BOILER; ELECTRICAL BUSWAYS, CONDUITS, AND CABLE TRAYS

- A. Support and brace mechanical piping; electrical busways, conduits and cable trays.
- B. 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.

- C. Seismic Restraint of Piping: Design criteria:
 - 1. Piping resiliently supported: Restrain to support 120 percent of the weight of the systems and components and contents.
 - 2. Piping not resiliently supported: Restrain to support 60 percent of the weight of the system components and contents.
- D. 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.

-- End of Section --

SECTION 23 05 10

COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 23 related to steam generation.
- B. Definitions:
 - 1. Exposed: Piping, and equipment exposed to view in finished rooms.
 - 2. Option or optional: Contractor's choice of an alternate material or method.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- C. Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE: Concrete and Grout.
- D. Section 07 84 00, FIRESTOPPING.
- E. Section 09 91 00, PAINTING.
- F. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- G. Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.

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 steam generating system, as applicable.
- B. Products Criteria:
 - 1. 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.

2. 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.
 3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
 4. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the COR.
 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. 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.
- D. 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 COR for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the COR at least two weeks prior to commencing installation of any item.

Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.

2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract drawings to the COR for resolution.
 3. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.
- E. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.

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 installation. Final review and approvals will be made only by groups.
- 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.

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.
- 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 COR.
 2. Equipment and materials identification.
 3. Fire-stopping materials.
 4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
- H. Maintenance Data and Operating Instructions:
1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
 2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

1.5 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

A. American Society of 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

B. 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

C. 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

D. National Fire Protection Association (NFPA):

70-08 National Electrical 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 COR. 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. 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 BOILER PLANT

- A. Plant Operation: Government employees will be continuously operating and managing all plant facilities, including temporary facilities, that serve the steam and condensate requirements of the medical center.
- B. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the COR during periods when the steam demands are not critical to the operation of the medical center. Provide at least one week advance notice to the COR.
- C. Phasing of Work: Comply with all requirements shown on drawings or specified.

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 LIFTING ATTACHMENTS

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

2.4 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.
- D. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
 - 1. 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 (1½ 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 (8½ inches) by 280 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.

4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color coded thumb tack in ceiling.

2.5 FIRESTOPPING

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

2.6 GALVANIZED REPAIR COMPOUND

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

2.7 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-69.
- B. 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 COR 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 COR for each job condition.
- C. 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 (1½ inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- D. 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 91 kg (200 pounds).
 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13 mm (1/2-inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

E. Supports for Piping Systems:

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

- c. Piping with Vertical Expansion and Contraction:
 - 1) Movement up to 20 mm (3/4-inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
 - 2) Movement more than 20 mm (3/4-inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
 - 4. Converter and Expansion Tank Hangers: May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.
- F. 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.
- G. Seismic Restraint of Piping: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Comply with MSS SP-127.

2.8 PIPE PENETRATIONS

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.

- B. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- C. 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.
- D. 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.
- E. 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.

2.9 PENETRATIONS

Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly. See Section 07 84 00, FIRESTOPPING.

2.10 SPECIAL TOOLS AND LUBRICANTS

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

2.11 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, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are required per manufacturer.
- 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 COR 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 COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
 - 3. Do not penetrate membrane waterproofing.
- F. Minor Piping: Generally, small diameter pipe runs from drips and drains, and other service are not shown but must be provided.
- G. 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.
- H. Protection and Cleaning:
 - 1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.
 - 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation.

Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

- I. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.
- J. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- K. Install steam piping expansion joints as per manufacturer's recommendations.
- 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. Plant Operation: Government employees will be continuously operating and managing all plant facilities, including temporary facilities, that serve the steam and condensate requirements of the medical center.
 - 4. Maintenance of Steam Supply and Condensate Return Service: Schedule all work to permit continuous steam and condensate service at pressures and flow rates as required by the medical center. At all times there shall be one spare boiler available and one spare pump for each service available, in addition to those required for serving the load demand. The spare boiler and pumps must be capable of handling the loads that may be imposed if the operating boiler or pump fails.
 - 5. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the COR during periods when the steam demands are not critical to the operation of the medical center. Provide at least one week advance notice to the COR.
 - 6. Phasing of Work: Comply with all requirements shown on drawings or specified.
 - 7. 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.

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

M. 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, piping.

3.2 PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the COR.
- B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.
- C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work.
- D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.
- E. Floor Supports:
 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete

bases and structural systems to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.

2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Boiler foundations shall have horizontal dimensions that exceed boiler base frame dimensions by at least 150 mm (6 inches) on all sides. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.
4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.3 MECHANICAL DEMOLITION

- A. 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 COR with regard to safety, fire safety, and maintenance of operations.
- B. 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, and other penetrations in an approved manner and in accordance with plans and specifications where specifically covered.
- C. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

3.4 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the new steam and condensate system, thoroughly clean and paint. Refer to Section 09 91 00, PAINTING.

- B. In addition, the following special conditions apply:
1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
 2. Material And Equipment Not To Be Painted Includes:
 - a. Motors, controllers, control switches, and safety switches.
 - b. Control and interlock devices.
 - c. Regulators.
 - d. Pressure reducing valves.
 - e. Control valves and thermostatic elements.
 - f. Lubrication devices and grease fittings.
 - g. Copper, brass, aluminum, stainless steel and bronze surfaces.
 - h. Valve stems and rotating shafts.
 - i. Pressure gauges and thermometers.
 - j. Glass.
 - k. Name plates.
 3. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
 4. Paint shall withstand the following temperatures without peeling or discoloration:
 - a. Condensate and feedwater -- 38°C (100°F) on insulation jacket surface and 120°C (250°F) on metal pipe surface.
 - b. Steam -- 52°C (125°F) on insulation jacket surface and 190°C (375°F) on metal pipe surface.
 5. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary.

3.5 IDENTIFICATION SIGNS

- A. Pipe Identification: Refer to Section 09 91 00, PAINTING.

- B. 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.
- C. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.

3.6 MOTOR AND DRIVE ALIGNMENT

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

3.7 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 COR 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.

3.8 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.

3.9 OPERATING AND PERFORMANCE TESTS

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

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

3.10 INSTRUCTIONS TO VA PERSONNEL

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

-- End of Section --

SECTION 23 07 11

HVAC AND BOILER PLANT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field applied insulation for thermal efficiency and condensation control for steam and condensate piping and equipment in mechanical rooms, for insulation requirements in manholes and DDT piping. See Section 33 63 00, STEAM ENERGY DISTRIBUTION.
- B. Definitions
 - 1. ASJ: All service jacket, white finish facing or jacket.
 - 2. Exposed: Piping, and equipment exposed to view in finished areas including mechanical-
 - 3. FSK: Foil-scrim-kraft facing.
 - 4. Hot: Piping handling media above 41°C (105°F).
 - 5. Density: kg/m³ - kilograms per cubic meter (Pcf - pounds per cubic foot).
 - 6. 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).
 - 7. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
 - 8. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.
 - 9. HPS: High pressure steam (415 kPa [60 psig] and above).
 - 10. HPR: High pressure steam condensate return.
 - 11. MPS: Medium pressure steam (110 kPa [16 psig] thru 414 kPa [59 psig]).
 - 12. MPR: Medium pressure steam condensate return.
 - 13. LPS: Low pressure steam (103 kPa [15 psig] and below).
 - 14. LPR: Low pressure steam condensate gravity return.
 - 15. PC: Pumped condensate.
 - 16. CPD: Condensate pump discharge.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- B. Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT and STEAM GENERATION: General requirements pertaining to mechanical Boiler Plant work.

C. Section 33 63 00, STEAM ENERGY DISTRIBUTION

1.3 QUALITY ASSURANCE

A. Refer to article QUALITY ASSURANCE, in Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT and STEAM GENERATION.

B. Criteria:

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

4.3.3.1 Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in 4.3.3.1.1 or 4.3.3.1.2, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

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

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

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

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

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces*.

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

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

3. Specified k factors are at 24°C (75°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: All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
1. Insulation materials: Specify each type used and state surface burning characteristics.
 2. Insulation accessory materials: Each type used.
 3. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
 4. Make reference to applicable specification paragraph numbers for coordination.

1.5 STORAGE AND HANDLING OF MATERIAL

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

1.6 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. Federal Specifications (Fed. Spec.):
- | | |
|-----------------|-----------------------------------------------------------------------------------------------------------------|
| L-P-535E (2)-99 | Plastic Sheet (Sheeting); Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid |
|-----------------|-----------------------------------------------------------------------------------------------------------------|
- B. 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 |

- C. American Society for Testing and Materials (ASTM):
- B209-07 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - C177-13 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
 - C411-05 Standard test method for Hot-Surface Performance of High-Temperature Thermal Insulation
 - C449-07 Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
 - C547-07 Standard Specification for Mineral Fiber pipe Insulation
 - C612-10 Standard Specification for Mineral Fiber Block and Board Thermal Insulation
 - C1136-10 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
 - D1668-97a (2006) Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
 - E84-10 Standard Test Method for Surface Burning Characteristics of Building Materials
- D. National Fire Protection Association (NFPA):
- 90A-09 Standard for the Installation of Air Conditioning and Ventilating Systems
 - 101-09 Life Safety Code
 - 251-06 Standard methods of Tests of Fire Endurance of Building Construction Materials
 - 255-06 Standard Method of tests of Surface Burning Characteristics of Building Materials
- E. Underwriters Laboratories, Inc (UL):
- 723 UL Standard for Safety Test for Surface Burning Characteristics of Building Materials with Revision of 09/08

PART 2 - PRODUCTS

2.1 MINERAL FIBER OR FIBER GLASS

- A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m³ (3 pcf), k = 0.037 (0.26) at 24°C (75°F), external insulation for temperatures up to 204°C (400°F) with foil scrim (FSK) facing.
- B. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24°C (75°F), for use at temperatures up to 230°C (450°F) with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

2.2 MINERAL WOOL OR REFRACTORY FIBER

Comply with Standard ASTM C612, Class 3, 450°C (850°F).

2.3 CELLULAR GLASS CLOSED-CELL

- A. Comply with Standard ASTM C177, ASTM C518, density 120 kg/m³ (7.5 pcf) nominal, k = 0.033 (0.29) at 24°C (75°F).
- B. Pipe insulation for use at temperatures up to 200°C (400°F) with all service vapor retarder jacket.

2.4 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance \leq 0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1½ inch) lap on longitudinal joints and minimum 75 mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity areas conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.
- 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-535, 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.

- G. Aluminum Jacket-Piping systems: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 13 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.

2.5 REMOVABLE INSULATION AND JACKETS

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

2.6 PIPE COVERING PROTECTION SADDLES

- A. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be cellular glass. Insulation at supports shall have same thickness as adjacent insulation.
- B. 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.

2.7 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.

2.8 MECHANICAL FASTENERS

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

- D. Bands: 13 mm (0.5 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.9 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°C (40°F) to 121°C (250°F). Below 4°C (40°F) and above 121°C (250°F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

2.10 FIRESTOPPING MATERIAL

Refer to Section 07 84 00, FIRESTOPPING.

2.11 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 COR for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories) systems. 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°C (60°F) and below. Lap and seal vapor retarder over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- E. Insulate PRVs, flow meters, and steam traps.

- 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. Equipment: Expansion tanks, flash tanks, hot water pumps, steam condensate pumps.
 - 2. In hot piping: Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 20 mm (3/4 inch) and smaller, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.
- 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. Provide vapor barrier jackets over insulation on all piping exposed to outdoor weather.
- L. Provide metal jackets over insulation as follows:
 - 1. All piping exposed to outdoor weather.
 - 2. Piping exposed in building, within 1800 mm (6 feet) of the floor, that connects to sterilizers, kitchen and laundry equipment. Jackets may be applied with pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling or floor penetrations.
 - 3. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.
- M. Firestop Pipe and Duct insulation: 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.

3.2 INSULATION INSTALLATION

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

2. Contractor's options for fitting, flange and valve insulation:
 - a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16°C (61°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°C (40°F), or above 121°C (250°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°C (60°F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
 - d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
 3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.
- B. Cellular Glass Insulation:
1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.
 2. Underground Piping Other than or in lieu of that specified in Section 33 63 00, STEAM ENERGY DISTRIBUTION: Type II, factory jacketed with a 3 mm laminate jacketing consisting of 3000 mm x 3000 mm (10 ft x 10 ft) asphalt impregnated glass fabric, bituminous mastic and outside protective plastic film.
 - a. Underground piping: Apply insulation with joints tightly butted. Seal longitudinal self-sealing lap. Use field fabricated or factory made fittings. Seal butt joints and fitting with jacketing as recommended by the insulation manufacturer. Use 100 mm (4 inch) wide strips to seal butt joints.
 - b. Provide expansion chambers for pipe loops, anchors and wall penetrations as recommended by the insulation manufacturer.
 - c. Underground insulation shall be inspected and approved by the COR as follows:
 - 1) Insulation in place before coating.
 - 2) After coating.
 - d. Sand bed and backfill: Minimum 75 mm (3 inches) all around insulated pipe or tank, applied after coating has dried.

3.3 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)					
		Nominal Pipe Size Millimeters (Inches)			
Operating Temperature Range/Service	Insulation Material	Less than 25 (1)	25 – 32 (1 – 1¼)	38 – 75 (1½ - 3)	100 (4) and Above
122°C-177°C (251°F-350°F) (HPS, MPS)	Mineral Fiber (Above ground piping only)	75 (3)	100 (4)	113 (4.5)	113 (4.5)
100°C-121°C (212°F-250°F) (HPR, MPR, LPS, vent)	Mineral Fiber (Above ground piping only)	62 (2.5)	62 (2.5)	75 (3.0)	75 (3.0)
38°C-94°C (100°F-200°F) (LPR)	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)

-- End of Section --

SECTION 23 22 13

STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

Steam, condensate and vent piping inside buildings. Outside steam distribution piping is covered in specification Section 33 63 00, STEAM ENERGY DISTRIBUTION.

1.2 RELATED WORK

- A. Firestopping Insulated Piping: Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.
- B. Seismic restraints for piping: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- C. 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.
- D. Underground steam and condensate distribution: Section 33 63 00, STEAM ENERGY DISTRIBUTION.

1.3 QUALITY ASSURANCE

Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, which includes welding qualifications.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Pipe and equipment supports. Submit calculations for variable spring and constant support hangers.
 - 2. Pipe and tubing, with specification, class or type, and schedule.
 - 3. Pipe fittings, including miscellaneous adapters and special fittings.
 - 4. Flanges, gaskets and bolting.
 - 5. Valves of all types.
 - 6. Strainers.

7. Pipe alignment guides.
 8. Expansion joints.
 9. Flexible ball joints: Catalog sheets, performance charts, schematic drawings, specifications and installation instructions.
 10. All specified steam system components.
 11. Gages.
 12. Thermometers and test wells.
 13. Seismic bracing details for piping.
- C. Coordination Drawings: Refer to Article, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- D. As-Built Piping Diagrams: Provide drawing as follows for steam and steam condensate piping and other central plant equipment.
1. One wall-mounted stick file for prints. Mount stick file in the Boiler plant or adjacent control room along with control diagram stick file.
 2. One set of reproducible drawings.

1.5 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. American Society of Mechanical Engineers/American National Standards Institute (ASME/ANSI):
- | | |
|-------------------|-------------------------------------------------------------------------------|
| B1.20.1-83(R2006) | Pipe Threads, General Purpose (Inch) |
| B16.3-2006 | Malleable Iron Threaded Fittings |
| B16.4-2006 | Gray Iron Threaded Fittings |
| B16.5-2003 | Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard |
| B16.9-2007 | Factory-Made Wrought Buttwelding Fittings |
| B16.11-2005 | Forged Fittings, Socket-Welding and Threaded |

B16.18-2012	Cast Copper Alloy Solder Joint Pressure Fittings
B16.22-2001	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
B16.24-2006	Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500
B16.39-98	Malleable Iron Threaded Pipe Unions, Classes 150, 250, and 300
B16.42-1998	Ductile iron pipe flanges and flanged fittings - Classes 150 and 300
B31.1-2007	Power Piping
B40.100-2005	Pressure Gauges and Gauge Attachments
Boiler and Pressure Vessel Code: SEC VIII D1-2001, Pressure Vessels, Division 1	

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

A53-2007	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A106-2008	Seamless Carbon Steel Pipe for High-Temperature Service
A116-2011	Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
A216-2008	Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
A285-01	Pressure Vessel Plates, Carbon Steel, Low-and-Intermediate-Tensile Strength
A307-2007	Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
A516-2006	Pressure Vessel Plates, Carbon Steel, for Moderate-and- Lower Temperature Service
B62-2009	Composition Bronze or Ounce Metal Castings

C. American Welding Society (AWS):

B2.1-00 Welding Procedure and Performance Qualifications

D. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:

SP-70-98 Cast Iron Gate Valves, Flanged and Threaded Ends

SP-71-97 Gray Iron Swing Check Valves, Flanged and Threaded Ends

SP-80-97 Bronze Gate, Globe, Angle and Check Valves

SP-85-94 Cast Iron Globe and Angle Valves, Flanged and Threaded Ends

E. National Board of Boiler and Pressure Vessel Inspectors (NB):

Relieving Capacities of Safety Valves and Relief Valves

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

2.2 PIPE AND TUBING

A. Steam Piping: Steel, ASTM A53, Grade B, seamless or ERW; ASTM A106 Grade B, Seamless; Schedule 40.

B. Steam Condensate and Pumped Condensate Piping: Copper water tube ASTM B88, Type K, hard drawn; or steel, ASTM A53, Grade B, Seamless or ERW, or ASTM A106 Grade B Seamless, Schedule 80.

C. Vent Piping: Steel, ASTM A53, Grade B, seamless or ERW; ASTM A106 Grade B, Seamless; Schedule 40, galvanized.

2.3 FITTINGS FOR STEEL PIPE

A. 50 mm (2 inches) and Smaller: Screwed or welded.

1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.

2. Forged steel, socket welding or threaded: ASME B16.11.

3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron, except for steam and steam condensate piping. Provide 300 pound malleable iron, ASME B16.3 for steam and steam condensate piping. Cast iron fittings or piping is not acceptable for steam and steam condensate piping. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
 4. Steam line drip station and strainer quick-couple blowdown hose connection: Straight through, plug and socket, screw or cam locking type for 15 mm (1/2 inch) ID hose. No integral shut-off is required.
 5. Unions: ASME B16.39.
- B. 65 mm (2½ inches) and Larger: Welded or flanged joints.
1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
 2. Welding flanges and bolting: ASME B16.5:
 - a. Steam service: Weld neck or slip-on, raised face, with non-asbestos gasket. Non-asbestos gasket shall either be stainless steel spiral wound strip with flexible graphite filler or compressed inorganic fiber with nitrile binder rated for saturated and superheated steam service 750°F and 1500 psi.
 - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main.

2.4 FITTINGS FOR COPPER TUBING

- A. Solder Joint: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
- B. Bronze Flanges and Flanged Fittings: ASME B16.24.
- C. Fittings: ANSI/ASME B16.18 cast copper or ANSI/ASME B16.22 solder wrought copper.

2.5 DIELECTRIC FITTINGS

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.

- C. 65 mm (2½ inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- D. Temperature Rating, 121°C (250°F) for steam condensate and as required for steam service.
- E. Contractor's option: On pipe sizes 2 inches and smaller, screwed end brass gate valves or dielectric nipples may be used in lieu of dielectric unions as approved by COR.

2.6 SCREWED JOINTS

- A. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.
- B. Pipe Thread: ANSI B1.20.

2.7 VALVES

- A. Asbestos packing is not acceptable.
- B. All valves of the same type shall be products of a single manufacturer.
- C. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2100 mm (7 feet) or more above the floor or operating platform.
- D. Shut-Off Gate Valves
 - 1. 50 mm (2 inches) and smaller: MSS-SP80, Bronze, 1034 kPa (150 lb.), wedge disc, rising stem, union bonnet.
 - 2. 65 mm (2½ inches) and larger: Flanged, outside screw and yoke.
 - a. High pressure steam 413 kPa (60 psig) and above nominal MPS system): Cast steel body, ASTM A216 grade WCB, 1034 kPa (150 psig) at 260°C (500°F), 11½ to 13 percent chrome stainless steel solid disc and seats. Provide 25 mm (1 inch) factory installed bypass with globe valve on valves 100 mm (4 inches) and larger.
 - b. All other services: MSS-SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.
- E. Globe and Angle Valves:
 - 1. Globe Valves:
 - a. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.) Globe valves shall be union bonnet with metal plug type disc.

- b. 65 mm (2½ inches) and larger:
 - 1) Globe valves for high pressure steam 413 kPa (60 psig) and above nominal MPS system): Cast steel body, ASTM A216 grade WCB, flanged, OS&Y, 1034 kPa (150 psig) at 260°C (500°F), 11½ to 13 percent chrome stainless steel disc and renewable seat rings.
 - 2) All other services: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for globe valves.

2. Angle Valves:

- a. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.) Angle valves shall be union bonnet with metal plug type disc.
- b. 65 mm (2½ inches) and larger:
 - 1) Angle valves for high pressure steam 413 kPa (60 psig) and above nominal MPS system): Cast steel body, ASTM A216 grade WCB, flanged, OS&Y, 1034 kPa (150 psig) at 260°C (500°F), 11½ to 13 percent chrome stainless steel disc and renewable seat rings.
 - 2) All other services: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for angle valves.

F. Swing Check Valves

- 1. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 psig), 45 degree swing disc.
- 2. 65 mm (2½ inches) and Larger:
 - a. Check valves for high pressure steam 413 kPa (60 psig) and above nominal MPS system: Cast steel body, ASTM A216 grade WCB, flanged, OS&Y, 1034 kPa (150 psig) at 260°C (500°F), 11½ to 13 percent chrome stainless steel disc and renewable seat rings.
 - b. All other services: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-71 for check valves.

2.8 STRAINERS

- A. Basket or Y Type. Tee type is acceptable for gravity flow and pumped steam condensate service.
- B. High Pressure Steam: Rated 1034 kPa (150 psig) saturated steam.
 - 1. 50 mm (2 inches) and smaller: Iron, ASTM A116 Grade B, or bronze, ASTM B62 body with screwed connections (250 psig).

2. 65 mm (2½ inches) and larger: Flanged cast steel or 1723 kPa (250 psig) cast iron.
- C. All Other Services: Rated 861 kPa (125 psig) saturated steam.
1. 50 mm (2 inches) and smaller: Cast iron or bronze.
 2. 65 mm (2½ inches) and larger: Flanged, iron body.
- D. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2½ times pipe area, with perforations as follows:
1. 75 mm (3 inches) and smaller: 20 mesh for steam and 1.1 mm (0.045 inch) diameter perforations for liquids.
 2. 100 mm (4 inches) and larger: 1.1 mm (0.045) inch diameter perforations for steam and 3.2 mm (0.125 inch) diameter perforations for liquids.

2.9 PIPE ALIGNMENT

Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.

2.10 EXPANSION JOINTS

- A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
- B. Minimum Service Requirements:
1. Pressure Containment for steam service 35-200 kPa (5-30 psig), rated 345 kPa (50 psig) at 148°C (298°F).
 2. Number of Full Reverse Cycles without failure: Minimum 1000.
 3. Movement: Recommended safety factor of manufacturer.
- C. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.
- D. Bellows - Internally Pressurized Type:
1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
 2. Internal stainless steel sleeve entire length of bellows.

3. External cast iron equalizing rings for services exceeding 340 kPa (50 psig).
 4. Welded ends, flanged ends.
 5. Design shall conform to standards of EJMA and ASME B31.1.
 6. Integral external cover.
 7. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
- E. 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 required.

2.11 STEAM SYSTEM COMPONENTS

A. Steam Pressure Reducing Valves in PRV Stations:

1. Service: Provide controlled reduced pressure to steam piping systems.
2. Type: Single-seated, diaphragm operated, spring-loaded, external or internal steam pilot-controlled, normally closed, adjustable set pressure. Pilot shall sense controlled pressure downstream of main valve.
3. Pressure control shall be smooth and continuous with maximum drop of 10 percent. Maximum flow capability of each valve shall not exceed capacity of downstream safety valve(s).
4. Main valve and pilot valve shall have replaceable valve plug and seat of stainless steel, monel, or similar durable material.
 - a. Pressure rating for high pressure steam: Not less than 1034 kPa (150 psig) saturated steam.
 - b. Connections: Flanged for valves 65 mm (2½ inches) and larger; flanged or threaded ends for smaller valves.
5. Select pressure reducing valves to develop less than 85 dbA at 1500 mm (5 feet) elevation above adjacent floor, and 1500 mm (5 feet) distance in any direction. Inlet and outlet piping for steam pressure reducing valves shall be Schedule 80 minimum for required distance to achieve required levels or sound attenuators shall be applied.

- B. Safety Valves and Accessories: Comply with ASME Boiler and Pressure Vessel Code, Section VIII. Capacities shall be certified by National Board of Boiler and Pressure Vessel Inspectors, maximum accumulation 10 percent. Provide lifting lever. Provide drip pan elbow.

- C. Steam PRV for Individual Equipment: Cast iron or bronze body, screwed or flanged ends, rated 861 kPa (125 psig) working pressure. Single-seated, diaphragm operated, spring loaded, adjustable range, all parts renewable.
- D. Flash Tanks: Horizontal or vertical vortex type, constructed of copper bearing steel, ASTM A516 or ASTM A285, for a steam working pressure of 861 kPa (125 psig) to comply with ASME Code for Unfired Pressure Vessels and stamped with "U" symbol. Perforated pipe inside tank shall be ASTM A53 Grade B, Seamless or ERW, or ASTM A106 Grade B Seamless, Schedule 80. Corrosion allowance of 1.6 mm (1/16 inch) may be provided in lieu of the copper bearing requirement. Provide data Form No. U-1.
- E. Steam Trap: Traps shall be the product of a single manufacturer. Provide trap sets at all low points and at 61 m (200 feet) intervals on the horizontal main lines. Trap type shall be float and thermostatic.
 - 1. Floats and linkages shall provide sufficient force to open trap valve over full operating pressure range available to the system. Unless otherwise indicated on the drawings, traps shall be sized for capacities indicated at minimum pressure drop as follows:
 - a. For equipment with modulating control valve: 1.7 kPa (1/4 psig), based on a condensate leg of 300 mm (12 inches) at the trap inlet and gravity flow to the receiver.
 - b. For main line drip trap sets and other trap sets at steam pressure: Up to 70 percent of design differential pressure. Condensate may be lifted to the return line.
 - 2. Trap bodies: Bronze, cast iron, or semi-steel, constructed to permit ease of removal and servicing working parts without disturbing connecting piping. For systems without relief valve traps shall be 5.
 - 3. Mechanism: Brass, stainless steel or corrosion resistant alloy. rated for the pressure upstream of the PRV supplying the system.
 - 4. Balanced pressure thermostatic elements: Phosphor bronze, stainless steel or monel metal.
 - 5. Valves and seats: Suitable hardened corrosion resistant alloy.
 - 6. Floats: Stainless steel.
- F. Thermostatic Air Vent (Steam): Brass or iron body, balanced pressure bellows, stainless steel (renewable) valve and seat, rated 861 kPa (125 psig) working pressure, 20 mm (3/4 inch) screwed connections. Air vents shall be balanced pressure type that responds to steam pressure-temperature curve and vents air at any pressure.

2.12 GAGES, PRESSURE AND COMPOUND

- A. ASME B40.1, Accuracy Grade 1A, (pressure, vacuum, or compound), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4½ inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Provide brass, lever handle union cock. Provide brass/bronze pressure snubber for gages in water service. Provide brass pigtail syphon for steam gages.
- C. Range of Gages: For services not listed provide range equal to at least 130 percent of normal operating range:

Low pressure steam and steam condensate to 103 kPa(15 psig)	0 to 207 kPa (30 psig)
Medium pressure steam and steam condensate nominal 413 kPa (60 psig)	0 to 689 kPa (100 psig)
High pressure steam and steam condensate nominal 620 kPa to 861 kPa (90 to 125 psig)	0 to 1378 kPa (200 psig)
Pumped condensate, steam condensate, gravity or vacuum (30" HG to 30 psig)	0 to 415 kPa (60 psig)

2.13 PRESSURE/TEMPERATURE TEST PROVISIONS

- A. Provide one each of the following test items to the COR:
 1. 6 mm (1/4 inch) FPT by 3 mm (1/8 inch) diameter stainless steel pressure gage adapter probe for extra long test plug. PETE'S 500 XL is an example.
 2. 90 mm (3½ inch) diameter, one percent accuracy, compound gage, 762 mm (30 inches) Hg to 689 kPa (100 psig) range.
 3. 0°C - 104°C (32°F-220°F) pocket thermometer one-half degree accuracy, 25 mm (one inch) dial, 125 mm (5 inch) long stainless steel stem, plastic case.

2.14 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, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and

pipe runs based on field measurements and at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

- B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- C. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Install convertors and other heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.
- D. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope steam, condensate and drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.
- E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints.
- G. Connect piping to equipment as shown on the drawings. Install components furnished by others such as flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- H. Where copper piping is connected to steel piping, provide dielectric connections.
- 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. Pipe vents to the exterior. Where a combined vent is provided, the cross sectional area of the combined vent shall be equal to sum of individual vent areas. Slope vent piping one inch in 40 feet (0.25 percent) in direction of flow. Provide a drip trap elbow on relief valve outlets if the vent rises to prevent backpressure. Terminate vent minimum 0.3 M (12 inches) above the roof or through the wall minimum 2.5 M (8 feet) above grade with down turned elbow.

3.2 PIPE JOINTS

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC 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. 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. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.
- B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.
- C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.
- D. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding packing.

3.4 STEAM TRAP PIPING

Install to permit gravity flow to the trap. Provide gravity flow (avoid lifting condensate) from the trap where modulating control valves are used. Support traps weighing over 11 kg (25 pounds) independently of connecting piping.

3.5 SEISMIC BRACING

Provide in accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.6 LEAK TESTING

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COR in accordance with the specified requirements. Testing shall be performed in accordance with the specification requirements.

- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Avoid excessive pressure on mechanical seals and safety devices.

3.7 FLUSHING AND CLEANING PIPING SYSTEMS

Steam, Condensate and Vent Piping: No flushing or chemical cleaning required. Accomplish cleaning by pulling all strainer screens and cleaning all scale/dirt legs during start-up operation.

3.8 OPERATING AND PERFORMANCE TEST AND INSTRUCTION

- A. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Adjust red set hand on pressure gages to normal working pressure.

-- End of Section --

SECTION 23 22 23

STEAM CONDENSATE PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

Steam condensate pumps for Heating, Ventilating and Air Conditioning.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- D. Section 23 22 13, STEAM AND CONDENSATE HEATING 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. Design Criteria:
 - 1. Pumps design and manufacturer shall conform to Hydraulic Institute Standards.
 - 2. Pump sizes, capacities, pressures, operating characteristics and efficiency shall be as scheduled.
 - 3. Select pumps so that required net positive suction head (NPSHR) does not exceed the net positive head available (NPSHA).
 - 4. Pump Driver: Furnish with pump. Size shall be non-overloading at any point on the head-capacity curve including one pump operation in a parallel or series pumping installation.
 - 5. Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard and other accessories specified. Statically and dynamically balance all rotating parts.
 - 6. Furnish each pump and motor with a nameplate giving the manufacturers name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current and motor efficiency.
 - 7. Test all pumps before shipment. The manufacturer shall certify all pump ratings.

- B. Receiver Tank: Cast iron with threaded openings for connection of piping and accessories and facilities for mounting float switches.
- C. Furnish seals for condensate pump with a minimum temperature rating of 121°C (250°F).
- D. Centrifugal Pumps: Bronze fitted with mechanical shaft seals.
 - 1. Designed to allow removal of rotating elements without disturbing connecting piping or pump casing mounting.
 - 2. Shafts: Stainless steel, AISI Type 416 or alloy steel with bronze shaft sleeves.
 - 3. Bearings: Regreaseable ball or roller type.
 - 4. Casing wearing rings: Bronze.
- E. Pump Operation:
 - 1. Float Switches: NEMA 1, mounted on receiver tank, to start and stop pumps in response to changes in the water level in the receiver and adjustable to permit the controlled water levels to be changed. Floats and connecting rods shall be copper, bronze or stainless steel.
 - 2. Alternator: Provide for duplex units to automatically start the second pump when the first pump fails in keeping the receiver water level from rising and to alternate the order of starting the pumps. For units 0.25 kW (1/3 horsepower) and smaller, the alternator may be the mechanical type for use in lieu of float switches.
- F. Control Cabinet for 3 Phase (0.37 kW (1/2 hp) and larger) Units: NEMA 1, UL approved, factory wired, enclosing all controls, with indicating lights, manual switches and resets mounted on the outside of the panel. Attach cabinet to the pump set with rigid steel framework, unless remote mounting is noted on the pump schedule.
 - 1. Motor starters: Magnetic contact types with circuit breakers or combination fusible disconnect switches. Provide low voltage control circuits (120 volt maximum) and "hand-off-automatic" (H-O-A) switches for each pump.
 - 2. Indicating lights for each pump: Green to show that power is on, red to show that the pump is running.
- G. Electric Wiring: Suitable for 93°C (200°F) service; enclosed in liquid-tight flexible metal conduit where located outside of control cabinet.
- H. Receiver Accessories:
 - 1. Water level gage glass: Brass with gage cocks which automatically stop the flow of water when the glass is broken. Provide drain on the lower gage cock and protection rods for the glass.

2. Thermometer: 34°C-216°C (100°F-420°F), mounted below minimum water level.

2.2 PRESSURE POWERED PACKAGE CONDENSATE PUMP

A. Pressure-Powered Pump Packages:

1. Pump packages shall be furnished and installed as a packaged assembly of the types, sizes, capacities, and characteristics as shown on the drawings. Pump package shall be rated for 185°C (365°F), maximum condensate temperatures.
2. Pump package(s) shall come completely piped and mounted on a steel skid including (1) receiver/reservoir, two positive displacement pressure-powered pumps as scheduled, interconnecting piping and valves, and all accessories as hereafter specified below:
 - a. Where required for clearance or installation, provide separate components without skid.
 - b. The receiver shall be of a steel elevated design, warranted for 1 year against defects in material and workmanship. Receiver shall be 150 PSIG ASME labeled and coded. Receiver shall be sized for the required condensate storage volume and flash steam capacity. Receiver shall be horizontally mounted and have openings of the appropriate size and number including: inlets, (1) vent opening, (1) NPT drain with pipe plug, (1) NPT anode opening with anode, and gauge glass openings with gauge glass set consisting of (2) brass isolation valves and guard rods, and red-line tubular glass. Replaceable magnesium anode, which retards the corrosive action of most waters and adds to the service life of the tanks, shall be furnished with each receiver for corrosion protection.
 - c. Pressure-powered pumps shall be non-electric as shown on the drawings. Units shall be constructed of 1034 kPa (150 psig) ASME labeled and coded fabricated steel body or cast iron, shall be float operated, and contain a condensate inlet baffle. Each unit shall have (1) inlet check valve, (1) outlet check valve, and gauge glass set with isolation valves.
 - d. The float operating mechanism shall have all moving components constructed of stainless steel and be of a snap acting design with no external seals or packing. The float mechanism shall contain a reinforced stainless steel float, (2) 300 series stainless steel open coil design springs, and spring calibration pins.
 - e. Pressure-powered pumps shall be of a non-cavitating design capable of operation on systems up to the maximum working pressure of the tank rating using steam, compressed air, or other compatible inert gas as the supply (motive) pressure. Units shall be capable of operating at temperatures up to 365°F when pumping from a 'closed' system using a compatible motive gas. Balance and fine tune motive pressure to be 138 kPa (20 psig) higher than the static backpressure.

- f. Adjust fill head height and receiver size as required by clearance or pipe inlet elevations.
 - g. Package shall include interconnecting piping between receiver/reservoir and the positive displacement pressure-powered pump(s). Interconnecting suction (fill) line shall be provided to each unit and each suction (fill) line shall include a gate valve for isolation.
 - h. Manufacturer shall provide the following for field installation on each pressure-powered pump:
 - 1) Cycle counter
 - 2) Removable insulation jacket
 - 3) Pressure gauge
 - 4) Drain piping
 - i. Provide the following components for each pump:
 - 1) Motive pressure reducing valve
 - 2) Safety relief valve(s)
 - 3) Motive pressure inlet strainer
 - 4) Pressure gauge with pigtail, as required
 - 5) Motive pressure drip trap(s)
 - 6) Motive pressure line check valve(s)
3. The package shall be factory tested as a complete unit using steam as the motive pressure. The pump manufacturer shall furnish appropriate assembly and parts drawings, and installation and operation manuals. The package shall be shipped completely assembled, or with connection match marks if package must be shipped as sub-assemblies.
- B. Removable Insulation Jacket:
1. The insulation jacket should be of sewn construction with Velcro fasteners and have openings for inlet, outlet, drain, and gauge glass.
 2. Materials:
 - a. Liner and jacket shall be silicone impregnated heavy duty glass fiber rated for a maximum temperature of 260°C (500°F).
 - b. Insulation shall be 25 mm (1 inch) minimum thickness, Type E needled glass fiber mat rated for a maximum temperature of 650°C (1200°F).

- c. Jacket shall be sewn with Nomex thread with a UV inhibitor.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Follow manufacturer's written instructions for pump mounting and start-up. Access/Service space around pumps shall not be less than minimum space recommended by pumps manufacturer.
- B. Permanently support in-line pumps by the connecting piping only, not from the casing or the motor eye bolt.
- C. Sequence of installation for base-mounted pumps:
 - 1. Level and shim the unit base and grout to the concrete pad.
 - 2. Shim the driver and realign the pump and driver. Correct axial, angular or parallel misalignment of the shafts.
 - 3. Connect properly aligned and independently supported piping.
 - 4. Recheck alignment.
- D. Pad-mounted Condensate Pump: Level, shim, bolt, and grout the unit base onto the concrete pad.
- E. Coordinate location of thermometer and pressure gauges as per Section 23 22 13, STEAM and CONDENSATE HEATING PIPING.

3.2 START-UP

- A. Verify that the piping system has been flushed, cleaned and filled.
- B. Lubricate pumps before start-up.
- C. Prime the pump, vent all air from the casing and verify that the rotation is correct. To avoid damage to mechanical seals, never start or run the pump in dry condition.
- D. Verify that correct size heaters-motor over-load devices are installed for each pump controller unit.
- E. Field modifications to the bearings and or impeller (including trimming) are not permitted. If the pump does not meet the specified vibration tolerance send the pump back to the manufacturer for a replacement pump. All modifications to the pump shall be performed at the factory.

-- End of Section --

SECTION 26 05 11

REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings.
- C. Conductor ampacities specified are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
 - 1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
 - 2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3. Certified: Materials and equipment which:
 - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Are periodically inspected by a NRTL.
 - c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
- B. Product Qualification:
 1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
 2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

- A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.
- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.
- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 1. Components of an assembled unit need not be products of the same manufacturer.
 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

3. Components shall be compatible with each other and with the total assembly for the intended service.
 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the COR a minimum of 15 working days prior to the manufacturer's performing the factory tests.
 2. Four copies of certified test reports shall be furnished to the COR two weeks prior to final inspection and not more than 90 days after completion of the tests.
 3. When materials and equipment fail factory tests, and re-testing and re-inspection is required, the Contractor shall be liable for all additional expenses for the Government to witness re-testing.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

Where the Government or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 MATERIALS AND EQUIPMENT PROTECTION

- A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
 2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
 3. Damaged equipment shall be repaired or replaced, as determined by the COR.
 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

- A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J – General Environmental Controls, OSHA Part 1910 subpart K – Medical and First Aid, and OSHA Part 1910 subpart S – Electrical, in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the Contractor.

- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
 - 1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
 - 2. Before initiating any work, a job specific work plan must be developed by the Contractor with a peer review conducted and documented by the COR and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
 - 3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the COR.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.
- C. Inaccessible Equipment:
 - 1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 - 2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
- D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety

switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

- B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.
- C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm²), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

1.12 SUBMITTALS

- A. Submit to the COR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION _____".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
- E. The submittals shall include the following:
 - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
 - 2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.

3. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.
- F. Maintenance and Operation Manuals:
1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
 3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
 4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
 - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
- G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
- H. After approval and prior to installation, furnish the COR with one sample of each of the following:
1. Each type of conduit coupling, bushing, and termination fitting.
 2. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The

length of the sample shall be sufficient to show all markings provided by the manufacturer.

3. Conduit hangers, clamps, and supports.
4. Each type of outlet box, manual motor starter, 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

- A. The Contractor shall furnish the instruments, materials, and labor for tests.
- B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
- C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Government.

1.15 WARRANTY

All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

1.16 INSTRUCTION

- A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.
- B. Furnish the services of competent instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be trained in operating theory as well as practical operation and maintenance procedures.
- C. A training schedule shall be developed and submitted by the Contractor and approved by the COR at least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

-- End of Section --

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 31 20 11, EARTH MOVING (SHORT FORM): Installation of conductors and cables in manholes and ducts.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

1.5 SUBMITTALS

- A. Submit the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - 1) Electrical ratings and insulation type for each conductor and cable.
 - 2) Splicing materials and pulling lubricant.
 - 2. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. American Society of Testing Material (ASTM):
D2304-10 Test Method for Thermal Endurance of Rigid Electrical Insulating Materials
- B. National Fire Protection Association (NFPA):
70-11 National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with NEMA, UL and as specified herein.
- B. All conductors shall be copper.
- C. Single Conductor and Cable:
 - 1. No. 12 AWG: Minimum size.
 - 2. No. 8 AWG and larger: Stranded.
 - 3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
 - 4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.
- D. Direct Burial Cable: UF or USE cable.
- E. Color Code:
 - 1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
 - 2. No. 8 AWG and larger: Color-coded using one of the following methods:
 - a. Solid color insulation or solid color coating.
 - b. Stripes, bands, or hash marks of color specified.
 - c. Color using 19 mm (0.75 inches) wide tape.
 - 3. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
 - 4. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

- 5. Color code for isolated power system wiring in accordance with the NEC.

2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
 - 1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
 - 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 - 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
 - 1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
 - 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 - 3. Splice and insulation shall be product of the same manufacturer.
 - 4. All bolts, nuts, and washers used with splices shall be cadmium-plated steel.
- D. Above Ground Splices for 250 kcmil and Larger:
 - 1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
 - 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 - 3. Splice and insulation shall be product of the same manufacturer.
- E. Underground Splices for No. 10 AWG and Smaller:
 - 1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper and aluminum conductors.
 - 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 - 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- F. Underground Splices for No. 8 AWG and Larger:
 - 1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper and aluminum conductors.
 - 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 - 3. Splice and insulation shall be product of the same manufacturer.

- G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.3 CONNECTORS AND TERMINATIONS

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be cadmium-plated steel.

2.4 WIRE LUBRICATING COMPOUND

- A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.
- B. Shall not be used on conductors for isolated power systems.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install conductors in accordance with the NEC.
- B. Install all conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- G. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
- H. Conductor and Cable Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
 - 2. Use nonmetallic pull ropes.
 - 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
 - 4. All conductors in a single conduit shall be pulled simultaneously.
 - 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- I. No more than three branch circuits shall be installed in any one conduit.
- J. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.2 INSTALLATION IN MANHOLES

- A. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.
- B. Fireproofing:
 - 1. Install fireproofing on low-voltage conductors where the low-voltage conductors are installed in the same manholes with medium-voltage conductors.
 - 2. Use fireproofing tape and apply the tape in a single layer, half-lapped, or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (1 inch) into each duct.
 - 3. Secure the fireproofing tape in place by a random wrap of glass cloth tape.

3.3 SPLICE AND TERMINATION INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

3.4 CONDUCTOR IDENTIFICATION

When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

3.5 FEEDER CONDUCTOR IDENTIFICATION

In each interior pullbox and each underground manhole and handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1½ inches) in diameter and 40 mils thick. Attach tags with plastic ties.

3.6 EXISTING CONDUCTORS

Unless specifically indicated on the plans, existing conductors shall not be reused.

3.7 DIRECT BURIAL CABLE INSTALLATION

- A. Tops of the cables:
 - 1. Do not install cables under railroad tracks.
 - 2. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
 - 3. Below road and other pavement surfaces: In conduit as specified, minimum 760 mm (30 inches) unless greater depth is shown.

- B. Under road and paved surfaces: Install cables in concrete-encased galvanized steel rigid conduits. Size not less than 50 mm (2 inches) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare.
- C. Work with extreme care near existing ducts, conduits, cables, and other utilities to prevent any damage.
- D. Excavation and backfill is specified in Section 31 20 11, EARTH MOVING (SHORT FORM). In addition:
 - 1. Place 75 mm (3 inches) bedding sand in the trenches before installing the cables.
 - 2. Place 75 mm (3 inches) shading sand over the installed cables.
 - 3. Install continuous horizontal 25 mm by 200 mm (1 inch x 8 inches) preservative-impregnated wood planking 75 mm (3 inches) above the cables before backfilling.
- E. Provide horizontal slack in the cables for contraction during cold weather.
- F. Install the cables in continuous lengths. Splices within cable runs shall not be accepted.
- G. Connections and terminations shall be listed submersible-type designed for the cables being installed.
- H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried cables.

3.8 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests: Inspect physical condition.
 - 2. Electrical tests:
 - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
 - b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
 - c. Perform phase rotation test on all three-phase circuits.

-- End of Section --

- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
81-83 IEEE Guide for Measuring Earth Resistivity,
Ground Impedance, and Earth Surface
Potentials of a Ground System Part 1: Normal
Measurements

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
- B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.
- C. Conductor sizes shall not be less than required by the NEC.
- D. Insulation: THHN-THWN.

2.2 GROUND RODS

- A. Copper clad steel, 5/8 inch diameter by 10 feet long.
- B. Quantity of rods shall be as required to obtain the specified ground resistance.

2.3 GROUND CONNECTIONS

- A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.
- B. Above Grade:
1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
 2. Connection to Building Steel: Exothermic-welded type connectors.
 3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.4 GROUND TERMINAL BLOCKS

At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.5 GROUNDING BUS BAR

Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section. Provide insulators and mounting brackets.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install grounding equipment in accordance with the NEC and as specified herein.
- B. System Grounding:
 - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.3 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS

Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium-voltage conductors, sized per NEC except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the switchgear ground bus, to all manhole grounding provisions and hardware, to the cable shield grounding provisions of medium-voltage cable splices and terminations, and to equipment enclosures.

3.4 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):
 - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
 - 2. Provide a supplemental ground electrode as required and bond to the grounding electrode system.

3.5 RACEWAY

- A. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.

3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
 4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
- D. Wireway Systems:
1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
 2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
 3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
 4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).
- E. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

3.6 CORROSION INHIBITORS

When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.7 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
- B. In operating rooms and at intensive care and coronary care type beds, bond the medical gas piping and medical vacuum piping at the outlets directly to the patient ground bus.

3.8 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.9 GROUND ROD INSTALLATION

- A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.
- B. For indoor installations, leave 100 mm (4 inches) of each rod exposed.
- C. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.
- D. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

3.10 ACCEPTANCE CHECKS AND TESTS

- A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.
- B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Below-grade connections shall be visually inspected by the COR prior to backfilling. The Contractor shall notify the COR 24 hours before the connections are ready for inspection.

-- End of Section --

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 09 91 00, PAINTING: Identification and painting of conduit and other devices.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

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. 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.
- C. Shop Drawings:
 - 1. Size and location of main feeders, panels and pull-boxes.
 - 2. Layout of required conduit penetrations through structural elements.
- D. Certifications: Two weeks prior to the final inspection, submit four copies of the following certifications to the COR:
 - 1. Certification by the manufacturer that the material conforms to the requirements of the drawings and specifications.
 - 2. Certification by the contractor that the material has been properly installed.

1.5 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

A. American National Standards Institute (ANSI):

C80.1-05	Electrical Rigid Steel Conduit
C80.3-05	Steel Electrical Metal Tubing
C80.6-05	Electrical Intermediate Metal Conduit

B. National Fire Protection Association (NFPA):

70-08	National Electrical Code (NEC)
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C. Underwriters Laboratories, Inc. (UL):

1-05	Flexible Metal Conduit
5-04	Surface Metal Raceway and Fittings
6-07	Electrical Rigid Metal Conduit - Steel
50-95	Enclosures for Electrical Equipment
360-093	Liquid-Tight Flexible Steel Conduit
467-07	Grounding and Bonding Equipment
514A-04	Metallic Outlet Boxes
514B-04	Conduit, Tubing, and Cable Fittings
514C-96	Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-05	Schedule 40 and 80 Rigid PVC Conduit and Fittings
651A-00	Type EB and A Rigid PVC Conduit and HDPE Conduit
797-07	Electrical Metallic Tubing
1242-06	Electrical Intermediate Metal Conduit - Steel

D. National Electrical Manufacturers Association (NEMA):

TC-3-04	PVC Fittings for Use with Rigid PVC Conduit and Tubing
FB1-07	Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

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. Rigid intermediate steel conduit (IMC): Shall conform to UL 1242 and ANSI C80.6.
 3. Electrical metallic tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 4 in (105 mm) and shall be permitted only with cable rated 600 V or less.
 4. Flexible galvanized steel conduit: Shall conform to UL 1.
 5. Liquid-tight flexible metal conduit: Shall conform to UL 360.
 6. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
 7. Surface metal raceway: Shall conform to UL 5.
- C. Conduit Fittings:
1. Rigid steel and IMC conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.

- d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - f. Sealing fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Electrical metallic tubing fittings:
- a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Compression couplings and connectors: Concrete-tight and rain-tight, with connectors having insulated throats.
 - d. Setscrew couplings and connectors: Use setscrews of case-hardened steel with hex head and cup point, to firmly seat in wall of conduit for positive grounding.
 - e. Indent-type connectors or couplings are prohibited.
 - f. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
3. Flexible steel conduit fittings:
- a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp-type, with insulated throat.
4. Liquid-tight flexible metal conduit fittings:
- a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

5. Direct burial plastic conduit fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.
 6. 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.
 7. 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 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 and equipped with rustproof boxes.
 3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
 4. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are required. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end

caps, and other fittings to match and mate with wireways as required for a complete system.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:

1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the COR prior to drilling through structural elements.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except where permitted by the as required by limited working space.

3.2 INSTALLATION, GENERAL

A. Install in accordance with UL, NEC, and as specified herein.

B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where shown on drawings.

C. Install conduit as follows:

1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut square, ream, remove burrs, and draw up tight.
6. Independently support conduit at 8 ft (2.4 m) on centers. Do not use other supports, i.e., suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts.
7. Support within 12 in (300 mm) of changes of direction, and within 12 in (300 mm) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.

9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. 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 required.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the COR.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only as approved by the COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of conduit in concrete that is less than 3 in (75 mm) thick is prohibited.
 - a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
 - b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.

- c. Install conduits approximately in the center of the slab so that there will be a minimum of 0.75 in (19 mm) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.

3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors 600 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 required.
- 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 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only, notwithstanding requirements otherwise specified in this or other sections of these specifications.
- B. Install UL approved sealing fittings that prevent passage of explosive vapors in hazardous areas equipped with explosion-proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.6 WET OR DAMP LOCATIONS

- A. Unless otherwise shown, use conduits of rigid steel or IMC.
- B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.

- C. Unless otherwise shown, use rigid steel or IMC conduit within 5 ft (1.5 m) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.

3.7 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. 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.

3.8 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 Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 0.25 in (6 mm) bolt size and not less than 1.125 in (28 mm) embedment.
 - b. Power set fasteners not less than 0.25 in (6 mm) diameter with depth of penetration not less than 3 in (75 mm).
 - c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.
- F. 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. 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 required, 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.

-- End of Section --

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, connection, and testing of wiring devices.

1.2 RELATED WORK

Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:

- a. Submit sufficient information to demonstrate compliance with drawings and specifications.
- b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.

2. Manuals:

- a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and information for ordering replacement parts.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

- a. Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

1.5 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. National Fire Protection Association (NFPA):
70-11 National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General: All receptacles shall comply with NEMA, NFPA, and UL.
 - 1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
 - 2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.
- B. Receptacles; 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.
- C. 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC.
- B. Install wiring devices after wall construction and painting is complete.
- C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.
- D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.
- E. Provide barriers in multigang outlet boxes to comply with the NEC.
- F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
- G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.
- H. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches.

- I. Install vertically mounted receptacles with the ground pin up. Install horizontally mounted receptacles with the ground pin to the right.
- J. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.
- K. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform manufacturer's required field checks in accordance with the manufacturer's recommendations. In addition, include visual inspection and tests:
 - 1. Inspect physical and electrical condition.
 - 2. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.
 - 3. 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.
 - 4. Test GFCI receptacles.

-- End of Section --

SECTION 31 20 11

EARTHWORK (SHORT FORM)

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies the requirements for furnishing all equipment, materials, labor and techniques for earthwork including excavation, fill, backfill and site restoration utilizing fertilizer, seed and/or sod.

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 materials, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable.
2. Existing Subgrade (except footings): Same materials as above paragraph, that are not capable of direct support of slabs, pavement, and similar items, with the possible exception of improvement by compaction, proofrolling, or similar methods of improvement.
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 COR approval.

B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for trenchwork throughout the job site.

C. Degree of Compaction: Degree of compaction is expressed as a percentage of maximum density obtained by the test procedure presented in AASHTO T99, AASHTO T180, Method A. ASTM D698, ASTM D1557, Method A.

D. The term fill means fill or backfill as appropriate.

1.3 RELATED WORK:

A. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.

B. Safety requirements: Section 01 35 26, SAFETY REQUIREMENTS.

1.4 CLASSIFICATION OF EXCAVATION:

A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on the 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. Classified Excavation: Removal and disposal of all material not defined as rock.

1.5 MEASUREMENT AND PAYMENT FOR EXCAVATION:

Measurement: The unit of measurement for excavation and borrow will be the cubic yard, computed by the average end area method from cross sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. Quantities should be computed by a Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS. The measurement will include authorized excavation of satisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement. The measurement will not include the volume of subgrade material or other material used for purposes other than directed. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow pits, unless used as borrow material, will not be measured for payment. The measurement will not include the volume of any excavation performed prior to taking of elevations and measurements of the undisturbed grade.

1.6 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Contractor shall submit procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.
- C. Qualifications of the commercial testing laboratory or Contractor's Testing facility shall be submitted.

1.7 APPLICABLE PUBLICATIONS:

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - T99-10 Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop

- | | |
|---------|----------------------------------------------------------------------------------------------------------------------------|
| T180-10 | Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10 lb) Rammer and a 457 mm (18 inch) Drop |
|---------|----------------------------------------------------------------------------------------------------------------------------|
- B. American Society for Testing and Materials (ASTM):
- | | |
|----------|-----------------------------------------------------------------------------------------------|
| C33-03 | Concrete Aggregate |
| D698-e1 | Laboratory Compaction Characteristics of Soil Using Standard Effort |
| D1140-00 | Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve |
| D1557-09 | Laboratory Compaction Characteristics of Soil Using Modified Effort |
| D2487-06 | Standard Classification of Soil for Engineering Purposes (Unified Soil Classification System) |
- C. Standard Specifications of Colorado State Department of Transportation, latest revision.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Fills: Materials approved from on site and off site sources having a minimum dry density of 1760 kg/m³ (110 pcf), a maximum Plasticity Index of 6, and a maximum Liquid Limit of 30.
- B. Granular Fill: Under concrete slab, granular fill shall consist of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Fine aggregate grading shall conform to ASTM C33 with a maximum of 3 percent by weight passing ASTM D1140, 75 micrometers (No. 200) sieve and no more than 2 percent by weight passing the 4.75 mm (No. 4) size sieve.
- C. Fertilizer: (5-10-5) delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.
- D. Seed: Grass mixture comparable to existing turf delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.
- E. Sod: Comparable species with existing turf. Use State Certified or State Approved sod when available. Deliver sod to site immediately after cutting and in a moist condition. Thickness of cut must be 19 mm to 32 mm (3/4 inch to 1¼ inches) excluding top growth. There shall be no broken pads and torn or uneven ends.

- F. Requirements For Offsite Soils: Offsite soils brought in for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCLP test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA SW-846.3-3a Method 5030/8020. TCLP shall be performed in accordance with EPA SW-846.3-3a Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the COR.
- G. Buried Warning and Identification Tape: Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specific below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED STEAM LINE BELOW" or similar wording. Color and printing shall be permanent, Unaffected by moisture or soil. Warning tape color codes:
1. Red: Electric
 2. White: Steam Systems
- H. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.076 mm (0.003 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise, and 8.6 MPa (1250 psi) crosswise, with a maximum 350 percent elongation.
- I. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.102 mm (0.004 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise and 8.6 MPa (1250 psi) crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 0.9 m(3 feet) deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.
- J. Detection Wire For Non-Metallic Piping: Detection wire shall be Insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 - EXECUTION

3.1 SITE PREPARATION:

- A. Clearing: Clearing within the limits of earthwork operations as described or designated by the COR. Work includes removal of trees, shrubs, fences,

foundations, incidental structures, paving, debris, trash and any other obstructions. Remove materials from the Medical Center Property.

- B. Grubbing: Remove stumps and roots 75 mm (3 inches) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inches) diameter, and nonperishable solid objects which will be 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 the areas within 4500 mm (15 feet) of new construction and 2250 mm (7'-6") of utility lines if such removal is approved in advance by the COR. Remove materials from the Medical Center. Trees and shrubs, shown to be transplanted, shall be dug with a ball of earth and burlapped in accordance with the latest issue of the, "American Standard for Nursery Stock", of the American Association of Nurserymen, Inc. Transplant trees and shrubs to a permanent or temporary position within two hours after digging. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding semi-annually with liquid fertilizer with a minimum analysis of 5 percent nitrogen, 10 percent phosphorus and 5 percent potash. Maintain plants moved to permanent positions as specified for plants in temporary locations until the conclusion of the contract. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in the construction area. Repair immediately damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including the roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Building materials shall not be stored closer to trees and shrubs that are to remain, than the farthest extension of their limbs.
- D. Stripping Topsoil: Unless otherwise indicated on the drawings, the limits of earthwork operations shall extend anywhere the existing grade is filled or cut or where construction operations have compacted or otherwise disturbed the existing grade or turf. Strip topsoil as defined herein, or as indicated in the geotechnical report, from within the limits of earthwork operations as specified above unless specifically indicated or specified elsewhere in the specifications. Topsoil shall be fertile, friable, natural topsoil of loamy character and characteristic of the locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by the COR. Eliminate foreign material, 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 the 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 the soil is wet so that the tilth of the soil will be destroyed.
 - 1. 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 the Medical Center Property.

- E. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION:

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope to its angle of repose banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities, in compliance with OSHA requirements.
 - 1. Extend shoring and bracing to the bottom of the excavation. Shore excavations that are carried below the elevations of adjacent existing foundations.
 - 2. If the bearing of any foundation is disturbed by excavating, improper shoring or removal of shoring, placing of backfill, and similar operations, provide a concrete fill support under disturbed foundations, as directed by COR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by COR.
- B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required, to keep excavations free of water and subgrades dry, firm, and undisturbed until approval of permanent work has been received from COR. Approval by the COR is also required before placement of the permanent work on all subgrades. When removed disturbed material is located where it is not possible to install and properly compact disturbed subgrade material with mechanically compacted sand or gravel, the COR should be contacted to consider the use of flowable fill. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 0.9 m (3 feet) of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system. Relieve hydrostatic head in pervious zones below subgrade elevation in layered soils to prevent uplift.
- C. Trench Earthwork:
 - 1. Utility trenches (except sanitary and storm sewer):
 - a. Excavate to a width as necessary for sheet piling and bracing and proper performance of the work.

- b. Grade bottom of trenches with bell-holes, scooped-out to provide a uniform bearing.
 - c. The length of open trench in advance of pipe laying shall not be greater than is authorized by the COR.
 - d. Provide buried utility lines with utility identification tape. Bury tape 300 mm (12 inches) below finished grade; under pavements and slabs, bury tape 150 mm (6 inches) below top of subgrade
 - e. Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm (12 inches) above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m (3 feet) of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.
 - f. Bedding shall be of the type and thickness to match existing. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Clean, coarse-grained sand classified in accordance with DOT, State Standard or by ASTM D2487 for bedding.
- D. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials that are determined by the COR 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 COR, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. When unsuitable material is encountered and removed, the 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 meters (yardage) in cut section only.
- E. Finished elevation of subgrade shall be as follows:
- 1. Pavement Areas - bottom of the pavement or base course as applicable.

2. Planting and Lawn Areas - 100 mm (4 inches) below the finished grade, unless otherwise specified.

3.3 FILLING AND BACKFILLING:

- A. General: Do not fill or backfill until all debris, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from the excavation. Proof-roll exposed subgrades with a fully loaded dump truck. Use excavated materials or borrow for fill and backfill, as applicable. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, and pipes coming in contact with backfill have been installed, and inspected and approved by COR.
- B. Placing: Place material in horizontal layers not exceeding 200 mm (8 inches) in loose depth and then compacted. Do not place material on surfaces that are muddy, frozen, or contain frost.
- C. Compaction: Use approved equipment (hand or mechanical) well suited to the type of material being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without the prior approval of the COR. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact each layer to not less than 95 percent of the maximum density determined. Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure.

3.4 GRADING:

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In unfinished areas fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside the building away from the building walls for a minimum distance of 3048 mm (10 feet) at a minimum five percent (5%) slope.
- D. The finished grade shall be 150 mm (6 inches) below bottom line of windows or other building wall openings unless greater depth is required.
- E. Place crushed stone or gravel fill under concrete slabs on grade tamped and leveled. The thickness of the fill shall be 150 mm (6 inches), unless otherwise indicated.

- F. Finish subgrade in a condition acceptable to the COR at least one day in advance of the paving operations. Maintain finished subgrade in a smooth and compacted condition until the succeeding operation has been accomplished. Scarify, compact, and grade the subgrade prior to further construction when approved compacted subgrade is disturbed by contractor's subsequent operations or adverse weather.
- G. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.5 LAWN AREAS:

- A. General: Harrow and till to a depth of 100 mm (4 inches), new or existing lawn areas to remain, which are disturbed during construction. Establish existing or design grades by dragging or similar operations. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed. Plant bed must be approved by COR before seeding or sodding operation begins.
- B. Finished Grading: Begin finish grading after rough grading has had sufficient time for settlement. Scarify subgrade surface in lawn areas to a depth of 100 mm (4 inches). Apply topsoil so that after normal compaction, dragging and raking operations (to bring surface to indicated finish grades) there will be a minimum of 100 mm (4 inches) of topsoil over all lawn areas; make smooth, even surface and true grades, which will not allow water to stand at any point. Shape top and bottom of banks to form reverse curves in section; make junctions with undisturbed areas to conform to existing topography. Solid lines within grading limits indicate finished contours. Existing contours, indicated by broken lines are believed approximately correct but are not guaranteed.
- C. Fertilizing: Incorporate fertilizer into the soil to a depth of 100 mm (4 inches) at a rate of 12 kg/100 m² (25 pounds per 1000 square feet).
- D. Seeding: Seed at a rate of 2 kg/100 m² (4 pounds per 1000 square feet) and accomplished only during periods when uniform distribution may be assured. Lightly rake seed into bed immediately after seeding. Roll seeded area immediately with a roller not to exceed 225 kg/m (150 pounds per foot) of roller width.
- E. Sodding: Topsoil shall be firmed by rolling and during periods of high temperature the topsoil shall be watered lightly immediately prior to laying sod. Sod strips shall be tightly butted at the ends and staggered in a running bond fashion. Placement on slopes shall be from the bottom to top of slope with sod strips running across slope. Secure sodded slopes by pegging or other approved methods. Roll sodded area with a roller not to exceed 225 kg/m (150 pounds per foot) of the roller width to improve contact of sod with the soil.
- F. Watering: The COR is responsible for having adequate water available at the site. As sodding is completed in any one section, the entire sodded area shall be thoroughly irrigated by the contractor, to a sufficient depth, that the underside of the new sod pad and soil, immediately below sod, is thoroughly wet. COR will be responsible for sod after installation and acceptance.

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 COR 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 debris, rubbish, and excess material from the Medical Center Property.

-- End of Section --

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. Work to be completed by Contractor includes, but is not necessarily limited to:
 - 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) bottom of pipe trench and to allow material to be excavated, piles to be driven, and concrete placed, in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation 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. Erosion is controlled.

2. 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.
 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 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. Capacities of pumps, prime movers, and standby equipment.
 5. Design calculations proving adequacy of system and selected equipment. The dewatering system shall be designed using accepted and professional methods of design and engineering consistent with the best modern practice. The dewatering system shall include the deep wells, wellpoints, and other equipment, appurtenances, and related earthwork necessary to perform the function.
 6. Detailed description of dewatering procedure and maintenance method.
 7. 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 de-watering 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 or damages to work in place 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 COR before discontinuing operation of dewatering system.

-- End of Section --

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 required.
- B. Construction shall include the following:
 - 1. Curb, gutter, and combination curb and gutter.
 - 2. Pedestrian Pavement: Walks, pedestrian crossings.
 - 3. Vehicular Pavement: Driveways, parking lots.

1.2 DESIGN REQUIREMENTS

Design all elements with the latest published version of applicable codes.

1.3 WEATHER LIMITATIONS

- A. Hot Weather: Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by COR.
- B. Cold Weather: Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by COR.

1.4 SELECT SUBBASE MATERIAL JOB-MIX

The Contractor shall retain a testing laboratory to design a select subbase material mixture and submit a job-mix formula to the COR, 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. Cost of the testing laboratory to be included in the Contractor's cost of project.

1.5 SUBMITTALS

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

- 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. Jointing Plan for all concrete areas.
- D. Concrete Mix Design.
- E. Concrete Test Reports
- F. Construction Staking Notes from Surveyor.
- G. Data and Test Reports: Select subbase material.
 - 1. Job-mix formula.
 - 2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

1.6 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - M147-65-UL Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)
- B. American Concrete Institute (ACI):
 - 211.1-91 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete (Reapproved 2009)
 - 211.2-98 Standard Practice for Selecting Proportions for Structural Lightweight Concrete (Reapproved 2004)
 - 305-10 Specification for Hot Weather Concreting

306-10 Specification for Cold Weather Concreting

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

- C94/C94M-12 Standard Specification for Ready Mixed Concrete
- C143/C143M-10a Standard Test Method for Slump of Hydraulic Cement Concrete
- C171-07 Standard Specification for Sheet Materials for Curing Concrete
- C309-11 Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete

PART 2 - PRODUCTS

2.1 GENERAL

A. Concrete Type: Concrete shall be as per Table 1 – Concrete Type, air entrained.

TABLE I – CONCRETE TYPE

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

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

B. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

TABLE II – MAXIMUM SLUMP – INCHES (MM)

TYPE	MAXIMUM SLUMP*
Curb & Gutter	3 inches (75 mm)
Pedestrian Pavement	3 inches (75 mm)
Vehicular Pavement	2 inches (50 mm) (Machine Finished) 4 inches (100 mm) (Hand Finished)
Equipment Pad	3 to 4 inches (75 to 100 mm)
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

2.2 REINFORCEMENT

The type, amount, and locations of steel reinforcement shall be as required.

2.3 SELECT SUBBASE

- 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, as follows.

GRADE REQUIREMENTS FOR SOILS USED AS SUBBASE MATERIALS, BASE COURSES AND SURFACES COURSES

AASHTO M147		Percentage Passing by Mass					
Sieve	Size	Grades					
(mm)	(in)	A	B	C	D	E	F
50	2	100	100				
25	1		75-95	100	100	100	100
9.5	3/8	30-65	40-75	50-85	60-100		
4.47	No. 4	25-55	30-60	35-65	50-85	55-100	70-100
2.00	No. 10	15-40	20-45	25-50	40-70	40-100	55-100
0.425	No. 40	8-20	15-30	15-30	25-45	20-50	30-70
0.075	No. 200	2-8	5-20	5-15	5-20	6-20	8-25

- 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, or as recommended by the geotechnical engineer and approved by the COR.
- 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 1/8 inch (3 mm) in any ten foot (3000 mm) long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 2 inches (50 mm) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.5 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
- B. Burlap having a weight of seven ounces (233 grams) or more per yard (square meter) when dry.
 - 1. Impervious Sheeting conforming to ASTM C171.
 - 2. Liquid Membrane Curing Compound conforming to ASTM C309, Type 1 or Type 2 and shall be free of paraffin or petroleum.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

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 8 inches (200 mm), and that when compacted, will produce a layer of the designated thickness.
 - 2. When the designated compacted thickness exceeds 6 inches (150 mm), 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 1/2 inch (13 mm) or more below the grade, excavate the top layer and replace with new material to a depth of at least 3 inches (75 mm) in compacted thickness.
- C. Compaction:
1. Perform compaction with approved hand or mechanical equipment 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.
- 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 3/8 inch (10 mm).
 2. The completed thickness shall be within 1/2 inch (13 mm) of the thickness required.
- 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 Government.

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.
 2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.
- B. Form Setting:
1. Clean and oil forms each time they are used.

2. 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.
3. 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.
4. Forms shall conform to line and grade with an allowable tolerance of 1/8 inch (3 mm) when checked with a straightedge and shall not deviate from true line by more than 1/4 inch (6 mm) at any point.
5. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
6. Make necessary corrections to forms immediately before placing concrete.
7. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

3.4 EQUIPMENT

- A. The COR 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. All reinforcement shall be supported for proper placement within the concrete section.
- B. Before the concrete is placed, the COR shall approve the reinforcement placement, which shall be accurately and securely fastened in place with suitable supports and ties.

3.6 PLACING CONCRETE - GENERAL

- A. Obtain approval of the COR before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete.
- C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.

- D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.
- E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.
- F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.
- G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.
- H. Cracked or Chipped Concrete Surfaces and Bird Baths. Cracked or chipped concrete and bird baths will not be allowed. Concrete with cracks or chips and bird baths will be removed and replaced to the nearest joints, and as approved by the COR, by the Contractor with no additional cost to the Government.

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 required.
- 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. 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 COR.

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 AND GUTTER

- A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/4 inch (6 mm) or as otherwise detailed.
- B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.
- C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.
- D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.
- E. Except at grade changes or curves, finished surfaces shall not vary more than 1/8 inch (3 mm) for gutter and 1/4 (6 mm) for top and face of curb, when tested with a 10 foot (3000 mm) straightedge.
- F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- G. Correct any depressions which will not drain. See Article 3.6, Paragraph H, above.
- H. Visible surfaces and edges of finished curb, gutter, and/or combination curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.11 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. Finish the surfaces to grade and cross section with a metal float, troweled smooth and finished with a broom moistened with clear water.
- B. Brooming shall be transverse to the line of traffic.
- C. Finish all slab edges, including those at formed joints, carefully with an edger.

- D. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 1/16 inch (2 mm) in depth.
- E. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 3/16 inch (5 mm) when tested with a 10 foot (3000 mm) straightedge.
- F. The thickness of the pavement shall not vary more than 1/4 inch (6 mm).
- G. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints at no additional cost to the Government.

3.12 CONCRETE FINISHING FOR VEHICULAR PAVEMENT

- A. Accomplish longitudinal floating with a longitudinal float not less than 10 feet (3000 mm) long and 6 inches (150 mm) wide, properly stiffened to prevent flexing and warping. Operate the float from foot bridges in a sawing motion parallel to the direction in which the pavement is being laid from one side of the pavement to the other, and advancing not more than half the length of the float.
- B. After the longitudinal floating is completed, but while the concrete is still plastic, eliminate minor irregularities in the pavement surfaces by means of metal floats, 5 feet (1500 mm) in length, and straightedges, 10 feet (3000 mm) in length. Make the final finish with the straightedges, which shall be used to float the entire pavement surface.
- C. Test the surface for trueness with a 10 foot (3000 mm) straightedge held in successive positions parallel and at right angles to the direction in which the pavement is being laid and the entire area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one half the length of the straightedge. Correct all irregularities and refinish the surface.
- D. The finished surface of the pavement shall not vary more than 1/4 inch (6 mm) in both longitudinal and transverse directions when tested with a 10 foot (3000 mm) straightedge.
- E. The thickness of the pavement shall not vary more than 1/4 inch (6 mm).
- F. When most of the water glaze or sheen has disappeared and before the concrete becomes nonplastic, give the surface of the pavement a broomed finish with an approved fiber broom not less than 18 inches (450 mm) wide. Pull the broom gently over the surface of the pavement from edge to edge. Brooming shall be transverse to the line of traffic and so executed that the corrugations thus produced will be uniform in character and width, and not more than 1/8 inch (3 mm) in depth. Carefully finish the edge of the pavement along forms and at the joints with an edging tool. The brooming shall eliminate the flat surface left by the surface face of the edger.

- G. The finish surfaces of new and existing abutting pavements shall be flush and in alignment at their juncture.

3.13 CONCRETE FINISHING EQUIPMENT PADS

- A. After the surface has been struck off and screeded to the proper elevation, provide a smooth dense float finish, free from depressions or irregularities.
- B. Carefully finish all slab edges with an edger.
- C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary more than 1/8 inch (3 mm) when tested with a 10 foot (3000 mm) straightedge.
- D. Correct irregularities exceeding the above. See Article 3.6, Paragraph H, above.

3.14 JOINTS - GENERAL

- A. Place joints where required 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 CONSTRUCTION JOINTS

- A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement.
- B. Place transverse construction joints, where required and whenever the placing of concrete is suspended for more than 30 minutes.
- C. Use a butt-type joint with dowels in curb and gutter if the joint occurs at the location of a planned joint.
- D. Use keyed joints with tiebars if the joint occurs in the middle third of the normal curb and gutter joint interval.

3.16 FORM REMOVAL

- A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.
- B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.17 CURING OF CONCRETE

- A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the COR.
- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).
- C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 4 mils (0.1 mm) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 12 inches (300 mm). Securely anchor sheeting.
- D. Liquid Membrane Curing:
 - 1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 200 square feet per gallon (5 m²/L) for both coats.
 - 2. 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.
 - 3. Do not allow the concrete to dry before the application of the membrane.
 - 4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

3.18 CLEANING

- A. After completion of the curing period:
 - 1. Remove the curing material (other than liquid membrane).
 - 2. Sweep the concrete clean.
 - 3. After removal of all foreign matter from the joints, seal joints as specified.
 - 4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.19 PROTECTION

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the COR, 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 COR.

3.20 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

-- End of Section --

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 required. Each course shall be rolled, finished, and approved before placement of the next course.

1.2 INSPECTION OF PLANT AND EQUIPMENT

The COR 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.

1.3 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.

1.4 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

Aggregate base, Asphaltic base and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the State Highway Material Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA COR or VA Contracting Officer.

2.2 AGGREGATES

- A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.
- B. Subbase aggregate (where required) maximum size: 38 mm (1½ inch).
- C. Base aggregate maximum size:
 - 1. Base course over 152 mm (6 inch) thick: 38 mm (1½ inch);
 - 2. Other base courses: 19 mm (¾ inch).
- D. Asphaltic base course:
 - 1. Maximum particle size not to exceed 25.4 mm (1 inch).
 - 2. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.
- E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

<u>Sieve Sizes</u>	<u>Percentage Passing</u>
19 mm (¾")	100
9.5 mm (⅜")	67 to 85
6.4 mm (¼")	50 to 65
2.4 mm (No. 8 mesh)	37 to 50
600 µm (No. 30 mesh)	15 to 25
75 µm (No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6½ percent of the combined dry aggregates.

2.3 ASPHALTS

A. Comply with provisions of Asphalt Institute Specification SS2:

1. Asphalt cement: Penetration grade 50/60
2. Prime coat: Cut-back type, grade MC-250
3. Tack coat: Uniformly emulsified, grade SS-1H

2.4 SEALER

- A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.
- B. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

PART 3 - EXECUTION

3.1 GENERAL

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

- A. Provide hot plant-mixed asphaltic concrete paving materials.
1. Temperature leaving the plant: 143°C (290°F) minimum, 160°C (320°F) maximum.
 2. Temperature at time of placing: 138°C (280°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 COR or 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 required to match existing conditions.
 - 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 required to match existing conditions.
 - 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 required to match existing conditions and within a tolerance of minus 0.0 mm (0.0 inch) to plus 12.7 mm (0.5 inch).
- D. Smoothness tolerance: Provide the lines and grades required to match existing conditions and within a tolerance of 5 mm 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 COR.
- 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°C (280°F).

2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10°C (50°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 76 mm (3 inch) 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 required.
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 3 mm in 1.8m (1/8 inch in six feet).

3.6 APPLICATION OF SEAL COAT

- A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- B. Apply one coat of the specified sealer.
- C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

3.7 PROTECTION

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.8 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

-- End of Section --

SECTION 32 84 00

PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for furnishing, installing and repairing a complete automatically-controlled lawn irrigation system, controllers and all other appurtenances necessary to serve specified landscape and plant bed areas.
- B. Disable, cut, cap and demolish irrigation system that is affected by the demolition of the pipe trenching. Restore the system to working condition for the duration of the construction.
- C. Disable and install new per this section.
- D. Work shall be phased according to general construction phasing.

1.2 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves.
- B. Drain Piping: Downstream from circuit-piping drain valves.
- C. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 volts or for remote-control, signaling power-limited circuits.

1.3 ABBREVIATIONS

- A. FPT: Female pipe thread
- B. HDPE: high-density polyethylene plastic
- C. NPT: National pipe thread
- D. PTFE: Polytetrafluoroethylene
- E. PVC: Polyvinyl chloride plastic
- F. WOG: Water, oil and gas

1.4 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of sprinklers and specialties are to match existing. Contractor to make minor adjustments necessary to avoid plantings and obstructions such as signs, utilities and light standards. Provide 100 percent irrigation coverage of areas indicated.
- C. Delegated Design: Provide a 100 percent coverage irrigation system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- D. Minimum Working Pressures: The following are maximum pressure requirements for piping, valves and specialties unless otherwise indicated.
 - 1. Irrigation Main Piping: 100 psi (640 kPa).
 - 2. Circuit Piping: 80 psi (520 kPa)

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support pipe to prevent sagging and bending.

1.6 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Installer Certification:
 - 1. Installer should be an employer of workers that include a certified irrigation designer qualified by The Irrigation Association Professional Class member of the American Society of Irrigation Consultants Professional Technical Class member of the American Society of Irrigation Consultants to perform specified work., and have provided irrigation installations for 5 years.
 - 2. Service provider qualifications shall be maintained and/or trained by the manufacturer to render satisfactory service within 8 hours of service request notification.
- C. System Requirements: 100 percent irrigation coverage of specified areas is required. The Contractor shall, at no additional cost to the Government, make minor adjustments necessary to avoid plantings and obstructions such as signs, utilities and light standards and achieve full and complete coverage of irrigated areas without overspray on roadways, sidewalks, window wells, or buildings and to protect trees from close high spray velocity.

1.7 SUBMITTALS

- A. Submit product data as one package for each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Submit the proposed irrigation system design signed and sealed by the qualified professional engineer licensed in Colorado and responsible for document preparation.
- C. Submit complete detailed irrigation layout covering design of system showing pipe sizes and lengths; fittings; locations; types and sizes of sprinklers; controls; backflow

preventers; valves; and connections to water supply main. Do not start work before final shop drawing approval.

- D. Provide qualification data for:
 - 1. A qualified irrigation Installer.
 - 2. A qualified service provider, maintained and/or trained by the manufacturer to render satisfactory service within 8 hours of service request notification.
- E. Include a zone chart and controller timing schedule showing each irrigation zone and its control valve; and show the time settings for each automatic controller zone.

1.8 EXTRA MATERIALS

- A. Furnish extra materials, as called out below, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Rotary and Spray Head Sprinklers Bubblers Emitters: 5 percent of amount installed for each type and size indicated, but no fewer than 2 units.

1.9 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

- A. American Society For Testing And Materials (ASTM):
 - D1785-06 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120
 - D2241-09 Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
 - D2464-06 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 - D2466-06 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
 - D2564-04(2009)e1 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
 - D2855-96(2010) Making Solvent Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
 - F477-10 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 - F656-10 Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- B. National Fire Protection Association (NFPA):
 - 70 2011 Edition National Electrical Code

1.10 WARRANTY

The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will provide all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 PIPES, TUBES AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. PVC pipe: ASTM D1785, PVC 1120 compound, Schedule 40.
 - 1. PVC socket fittings shall be ASTM D2466, Schedule 40.
 - 2. PVC threaded fittings: ASTM D2464, Schedule 80.
 - 3. Swing joints: Threaded fittings with elastomeric seals that allow 360 degree rotation, and designed for minimum 200 psi (1375 kPa) working pressure, may be used in lieu of standard threaded fittings.
 - 4. PVC socket unions: Both headpiece and tailpiece shall be PVC with socket ends.

2.2 PIPE JOINING MATERIALS

- A. Solvent cements for joining PVC piping: ASTM D2564. Include primer according to ASTM F656.
- B. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 VALVES

- A. Underground Shut-Off Valves: Ball valves, isolation valves, 1½ inch (38 mm) and smaller, full-port ball valves with bronze body, PTFE seats, and 90 degree on/off handle. Ball valves to have NPT female end connections.
- B. Operations:
 - 1. Underground applications shall use valves with 2 inch (50 mm) nut for T-Handle socket wrench operation.
 - 2. Aboveground and valve pit applications shall use valves, with handwheels.
 - 3. Valve ends shall accommodate the type of main pipe adjacent to valve.

2.4 SPRINKLER HEADS

- A. Sprinkler heads: Heads to be located to match existing locations. The entire internal assembly including filter screen, to be capable of removal from the top without removing the sprinkler case from the riser.
- B. Rotary pop-up sprinklers: Gear-driven.
 - 1. Full circle sprinklers shall be dual or tri-nozzle combination type with positive drive by means of a water-driven gear assembly. Sprinkler head to rotate

uniformly and to be driven by means of a train of gears. Sprinklers to be equipped with an integral anti-drain valve to be self-closing at pressures of 10 feet (3.0 m) of head or less. Gears and pinions shall be assembled on stainless steel spindles in a water-lubricated sandproof gear case. An inlet screen shall prevent debris from entering the sprinkler and shall be removable with the internal assembly. Sprinklers outer case shall be constructed of corrosion resistant, impact resistant, heavy-duty ABS.

2. Part circle sprinklers shall be variable arc type as required with same type drive used for full circle heads.

C. Drip Emitters shall be of the pressure compensating, permanently assembled type with 1/2 inch (1.25 cm) FPT inlet. Emitters shall be capable of providing 1 GPM (3.8 LPM) at inlet pressures between 15 and 50 psi (105 and 342 kPa).

D. Emitter distribution tubing shall be constructed of UV resistant vinyl material with a 0.22 inch (5.5 mm) O.D. and a 0.16 inch (4 mm) I.D. Tubing shall be manufactured by the same manufacturer as the drip emitters.

2.5 QUICK COUPLERS

A. Quick couplers shall have all parts contained in a two-piece unit and shall consist of a coupler water seal valve assembly and a removable upper body to allow the spring and key track to be serviced without shut down of the main.

B. Metal parts shall be brass.

C. Lids shall be lockable vinyl covered and have springs for positive closure on key removal.

2.6 LOW VOLTAGE CONTROL VALVE WIRE

Wire shall be solid copper wire, Underwriters Laboratories Inc. approved for direct burial in ground. Size of wire shall be in accordance with manufacturer's recommendations, never less than No. 14.

2.7 SPLICING MATERIALS: EPOXY WATERPROOF SEALING PACKET. LOW VOLTAGE CONTROLLER CABLE

Multi-strand cable, UL-approved for direct burial in ground. Size and type of wire shall be in accordance with manufacturer's recommendations.

2.8 SLEEVE MATERIAL

ASTM D2241, Schedule 40.

2.9 WARNING TAPE

Provide standard, 4-Mil polyethylene 3 inch (76 mm) wide tape, detectable type blue with black letters (if potable water), or purple with black letters (if reclaimed or untreated well water), and imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW".

2.10 TRACER WIRES

Tracer Wires shall be No. 14, Green, Type TW plastic-coated copper tracer wire shall be installed with non-metallic irrigation main lines.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine proposed irrigation areas for compliance with requirements and conditions affecting installation and performance.
- B. Set stakes to identify locations of proposed irrigation system. Obtain COR approval before excavation.

3.2 PIPE INSTALLATION - GENERAL

- A. Layout work as closely as possible to existing conditions. Swing joints, offsets and all fittings are not shown. Lines are to be in a common trench wherever possible.
- B. Install sprinkler lines to avoid heating, ventilating, and air conditioning trenches; electric ducts; storm and sanitary sewer lines; and existing water and gas mains; all of which have the right of way.
- C. Existing sidewalks and curbs shall not be cut during trenching and installation of pipe. Install pipe under sidewalks and curbs by jacking, auger boring, or by tunneling. Repair or replace any cracked concrete, due to settling, during the warranty period.
- D. Do not lay pipe on unstable material, in wet trenches or, in the opinion of COR, when trench or weather conditions are unsuitable for work.
- E. Allow a minimum of 3 inches (80 mm) between parallel pipes in the same trench.
- F. Clean the interior portion of pipe and fittings of foreign matter before installation. Securely close open ends of pipe and fittings with caps or plugs to protect fixtures and equipment against dirt, water and chemical or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- G. The full length of each section of pipe shall rest upon the pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipe on wood blocking.
- H. Hold pipe securely in place while joint is being made.
- I. Do not work over, or walk on, pipe in trenches until covered by layers of earth, well tamped, in place to a depth of 12 inches (300 mm) over pipe.
- J. Irrigation lines and control wire shall run through designated utility lanes or beside roadways where possible.
- K. Connect repaired system to existing mains.
- L. Minimum cover over water mains shall be 30 inches (750 mm). Cover laterals to minimum depth of 24 inches (600 mm).
- M. Warning tape shall be continuously placed 12 inches (300 mm) above sprinkler system water mains and laterals.

3.3 PLASTIC PIPE INSTALLATION

- A. Plastic pipe shall be snaked in trench at least 1 foot per 100 feet (1 meter to 100 meters) to allow for thermal construction and expansion and to reduce strain on connections.
- B. Joints
 - 1. Solvent Welded Socket Type: ASTM D2855.

2. Threaded Type: Apply liquid teflon thread lubricant of teflon thread type. After joint is made hand tight (hard), a strap wrench should be used to make up to two additional full turns.
3. Elastomeric Gasket: ASTM F477.

3.4 EMITTER HOSE INSTALLATION

- A. Joint: Solvent weld connection.
- B. Bushing: Adaptation from PVC Schedule 40 fittings to flex vinyl hose shall be line size by 3/8 inch (10 mm) insert bushings.

3.5 SLEEVE INSTALLATION

- A. Furnish and install where pipe and control wires pass under walks, paving, walls, and other similar areas.
- B. Sleeves to be twice line size or greater to accommodate retrieval for repair of wiring or piping and shall extend 12 inches (300 mm) beyond edges of paving or construction.
- C. Bed sleeves with a minimum of 4 inches (100 mm) of sand backfill above top of pipe in areas where pipe is placed prior to hardscape is installed.

3.6 VALVE INSTALLATION

- A. No valves shall be set under roads, pavement or walks.
- B. Clean interior of valves of foreign matter before installation.
- C. Pressure control valves installed adjacent to remote control valve shall be housed in the same valve box.
- D. Set valve box cover flush with finished grade.
- E. Control valves shall never be less than 3 inches (80 mm) below finished grade.

3.7 SPRINKLER AND QUICK COUPLER INSTALLATION

- A. Sprinkler heads and quick couplers shall be placed on temporary nipples extending at least 3 inches (80 mm) above finished grade. After turf is established, remove temporary nipples, ensuring that no dirt or foreign matter enters outlet, and install sprinkler heads and quick couplers at ground surface as detailed.
- B. Place part circle rotary sprinkler heads no more than 6 inches (150 mm) from edge, of and flush with top of adjacent walks, header boards, curbs, and mowing aprons, or paved areas at time of installation.
- C. Install all sprinklers, shrub sprays and quick couplers on swing joints, as detailed on plans.
- D. Set shrub heads 8 inches (200 mm) above grade and 1 foot (300 mm) from edge of curb or pavement. Place adjacent to walls. Stake heads prior to backfilling trenches. Support stakes to be parallel to riser.
- E. Each sprinkler section shall drain to waste valves placed at lowest elevation points in the system. Waste valves shall discharge to drainage pits composed of three 1 foot (300 mm) long vertical sections of 24 inch (600 mm) diameter sewer pipe placed under the lawn areas. Fill pipe with gravel and cover with 2 inch (50 mm) precast

concrete cover before backfilling. Waste valves may also discharge to storm sewers, where available.

3.8 FIELD TEST AND QUALITY CONTROL

- A. Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. Pressure test lines before joint areas are backfilled. Backfill a minimum of 12 inches (300 mm) over the pipe to maintain pipe stability during test period. Test piping at hydraulic pressure of 150 psi (1025 kPa) for two hours. Maximum loss shall be 0.8 gallons/inch pipe diameter/1,000-feet (3 L/25 mm pipe diameter/300 m). Locate pump at low point in line and apply pressure gradually. Install pressure gage shut-off valve and safety blow-off valve between pressure source and piping. Inspect each joint and repair leaks. Line shall be retested until satisfactory.
 - 2. After testing, flush system with a minimum of 150 percent of operating flow passing through each pipe beginning with larger mains and continuing through smaller mains in sequence. Flush lines before installing sprinkler heads and quick couplers.
 - 3. After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 4. After electrical circuitry has been energized and final adjustment of the sprinkler heads to permanent level at ground surface is complete, test each sprinkler section by the pan test and visual test to indicate a uniform distribution within any one sprinkler head area and over the entire area. Operate controllers and automatic control valves to demonstrate the complete and successful installation and operation of all equipment.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Any irrigation product will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.9 ADJUSTMENTS

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch (13 mm) above, finish grade.

3.10 DEMONSTRATION AND DOCUMENTATION

- A. Prior to final acceptance, verbal instructions, for a period of not less than 8 hours, shall be provided to the operating personnel. Provide 2 additional years of software support for one hour each month.
- B. Program controller and satellites according to approved irrigation schedule.
- C. Follow manufacturer's instructions for installation.

- D. Manufacturer of Control Systems shall certify control system is complete, including all related components, and totally operational. Submit certificate to COR.
- E. Maintain and provide a complete set of as built drawings which shall be corrected daily to show changes in locations of all pipe, valves, pumps and related irrigation equipment. Valves shall be shown with dimensions to reference points.

-- End of Section --

SECTION 32 90 00

PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

The work in this section consists of furnishing and installing plant, soils, edging turf, grasses and landscape materials required as specified in locations required to repair damage done by demolition and new construction of pipe trenching.

1.2 DELIVERY, STORAGE AND HANDLING

- A. Notify the COR of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant and landscape materials from the job site immediately.
- B. Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable. Keep seed and other packaged materials in dry storage away from contaminants.
- C. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants. Keep bulk materials in dry storage away from contaminants.
 - 2. Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk fertilizers lime and soil amendments with appropriate certificates.
- D. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- E. Handle planting stock by root ball.
- F. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than 6 hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
- G. Harvest, deliver, store, and handle sod according to requirements in TPI's "Guideline Specifications to Turfgrass Sodding". Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage, seed contamination and drying.
- H. Deliver sprigs in air tight bags to keep from drying out. Sprigs delivered unwrapped, shall be kept moist in burlap or other accepted material until planting.
- I. Deliver plugs within 24 hours of harvesting, keep moist until planting.
- J. All pesticides and herbicides shall be properly labeled and registered with the U.S. Department of Agriculture. Deliver materials in original, unopened containers showing,

certified analysis, name and address of manufacturer, product label, manufacturer's application instructions specific to the project and indication of conformance with state and federal laws, as applicable.

1.3 PROJECT CONDITIONS

- A. Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- C. Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.
- D. Plant trees, shrubs, and other plants after finish grades and irrigation system components are established but not before irrigation system components are installed, tested and approved unless otherwise indicated. When planting trees, shrubs, and other plants, protect irrigation system components and promptly repair damage caused by planting operations.

1.4 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
 - 1. Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association with 3 years experience in landscape installation.
 - 2. Pesticide Applicator: Licensed in state of project, commercial.
- C. Provide quality, size, genus, species, variety and sources of plants indicated, complying with applicable requirements in ANSI Z60.1.
- D. Include product label and manufacturer's literature and data for pesticides and herbicides.

1.5 SUBMITTALS

- A. Submit product data for each type of product indicated, including soils:
 - 1. Include quantities, sizes, quality, and sources for plant materials.

- C. Turfgrass Producers International (TPI):
Guideline Specifications to Turfgrass Sodding.

1.9 WARRANTY

- A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance, unless noted otherwise below. Further, the Contractor will provide all manufacturer's and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.
- B. Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
 - 2. Structural failures including plantings falling or blowing over.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. Plant and turf materials: Shall match existing and be in accordance with ANSI Z60.1.
- B. Make substitutions only when a plant (or alternates as specified) is not obtainable and the COR authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant with the same essential characteristics and an equitable adjustment of the contract price.
- C. Existing plants to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.
- D. Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

2.2 INORGANIC SOIL AMENDMENTS

Match existing.

2.3 ORGANIC SOIL AMENDMENTS

Match existing.

2.4 PLANT AND TURF FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

- B. Slow-Release Fertilizer: Granular or pellet fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- C. Plant Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 - 1. Nutrient Composition shall be 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.5 PLANTING SOILS

Match existing and be in accordance with ASTM D5268.

2.6 EROSION CONTROL

- A. Erosion control blankets: Biodegradable wood excelsior, straw, or coconut fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended biodegradable staples, 6 inches (150 mm) long.
- B. Erosion control fiber mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended biodegradable staples, 6 inches (150 mm) long.
- C. Erosion control mats: Cellular, non-biodegradable slope stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface.

2.7 WATER

Water shall not contain elements toxic to plant life. Water to be obtained from VA Medical Center at no cost to the Contractor.

2.8 ANTIDESICCANT

Antidesiccant: An emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

2.9 PESTICIDES

Consider IPM (Integrated Pest Management) practices to minimize the use of all pesticides and chemical products. Obtain approval of COR for allowable products, product alternatives, scheduling and application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions according to manufacturer's written instructions and warranty requirements. Pesticides to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
 5. Special conditions may exist that warrant a variance in the specified planting dates or conditions. Submit a written request to the COR stating the special conditions and proposal variance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by COR and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 GROUND COVER AND PLANT INSTALLATION

- A. Use planting soil for backfill.
- B. Dig holes large enough to allow spreading of roots.
- C. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.
- G. Plant ground cover in areas to receive erosion control materials through the material after erosion control materials are in place.

3.4 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring plant saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.5 PREPARATION FOR EROSION-CONTROL MATERIALS.

- A. Prepare area as specified in "Turf Area Preparation and Grading" Article.
- B. For erosion control mats, install planting soil in two lifts, with second lift equal to thickness of erosion control mats. Install erosion control mat and fasten with biodegradable materials as recommended by material manufacturer.
- C. Fill cells of erosion control mat with planting soil and compact before planting.
- D. For erosion control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten with biodegradable materials as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.6 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify COR before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Applied to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Applied only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.7 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- D. Erect temporary fencing or barricades and warning signs, as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

- E. After installation remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- F. Remove nondegradable erosion control measures after grass establishment period.
- G. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

-- End of Section --

SECTION 33 63 00

STEAM ENERGY DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of underground steam distribution and condensate return piping system, including existing manholes and outside of buildings. System shall be pre-engineered direct-buried drainable-dryable-testable (DDT).
- B. This section applies to all direct-buried steam and condensate piping, piping in existing manholes, and short section of piping after it enters the building. For steam and condensate piping in building mechanical rooms see Section 23 07 11, HVAC AND BOILER PLANT INSULATION and Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING.

1.2 RELATED WORK

- A. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Steam and Condensate Piping Insulation: Section 23 07 11, HVAC AND BOILER PLANT INSULATION.
- C. Steam and Condensate Piping: Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING.

1.3 DEFINITIONS

- A. System: The complete underground steam and condensate distribution system including all components such as carrier piping, pipe supports, insulation, protective enclosures, anchors, corrosion protection and accessories.
- B. Pre-Engineered Direct-Buried System: The factory-fabricated system.
- C. Drainable-Dryable-Testable (DDT) Pre-Engineered Direct-Buried System: A factory-fabricated system.
- D. Carrier Pipe: Pipe carrying the steam or condensate.
- E. Encasement Pipe: Outer protective pipe on any main line pipe. Carrier pipe and insulation are within the casing.
- F. HP Systems: High-pressure piping operating at more than 15 psi (104 kPa) as required by ASME B31.1.
- G. LP Systems: Low-pressure piping operating at 15 psi (104 kPa) or less as required by ASME B31.9.

1.4 ABBREVIATIONS

- A. HDPE: high-density polyethylene
- B. RTRP: reinforced thermosetting resin plastic
- C. RTRF: reinforced thermosetting resin fittings
- D. WOG: water, oil and gas

1.5 DELIVERY, STORAGE AND HANDLING

- A. The Contractor is solely responsible for the protection of equipment and material against damage.
- B. Protect piping systems against the entry of water, mud or other foreign substances by installing watertight covers on open ends at all times. Protect direct-buried system coatings from ultraviolet light (sunlight).
- C. Existing equipment worked on by the Contractor or in the Contractor's working area shall be considered to be in the custody and responsibility of the Contractor.
- D. All insulated piping systems exposed to water must be replaced prior to installation.

1.6 COORDINATION

Coordinate exterior steam lines and connections to building services up to the actual extent of building wall.

1.7 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Contractor shall restore damaged items to as-new operating condition or replace damaged items as directed by the COR, at no additional cost to the Government.
- C. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.
- D. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with provisions in ASME B31.9, Building Services Piping ASME B31.1, Power Piping.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. ASME Compliance: Comply with ASME B31.9, Building Services Piping, ASME B31.1, Power Piping, for materials, products, and installation.
- F. ASME Compliance: Safety valves and pressure vessels shall bear appropriate ASME labels.

1.8 SUBMITTALS

Manufacturers' Literature and Data shall be submitted, as one package, for pipes, fittings and appurtenances, including jointing materials, insulation, hangars and other miscellaneous items.

1.9 APPLICABLE PUBLICATIONS

The publications (in their entirety) listed below form a part of this specification. The publications are referenced in the text by the basic designation only. The most current dates of all listed publications at the date of the bid shall be the standard for all work in this project. The listed dates may have been updated prior to the date of bid. The applicable publications include, but are not limited to, the following:

A. Federal Specifications (Fed. Spec.):

A-A-60005 NOT 1 Frames, Covers, Grating, Steps, Sump and Catch Basin, Manhole

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

A36/A36M-08 Carbon Structural Steel

A47/A47M-99(2009) Ferritic Malleable Iron Castings

A53/A53M-10 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A105/A105M-10a Carbon Steel Forgings for Piping Applications

A106/A106M-10 Seamless Carbon Steel Pipe for High-Temperature Service

A126-04(2009) Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A139/A139M-04(2010) Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)

A167-99(2009) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

A193/A193M-10a Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

A194/A194M-10a Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

A197/A197M-00(2006) Cupola Malleable Iron

A234/A234M-10b Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

A666-10 Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

A733-03(2009) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

B61-08 Steam or Valve Bronze Castings

C411-05 Hot-Surface Performance of High-Temperature Thermal Insulation

C449-07	Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
C450-08	Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
C547-07	Mineral Fiber Pipe Insulation
C585-10	Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
C591-09	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
C1136-10	Flexible, Low Permeance Vapor Retarders for Thermal Insulation
E84-10b	Surface Burning Characteristics of Building Materials
C.	American Society of Mechanical Engineers (ASME):
B1.20.1-2006	Pipe Threads, General Purpose (Inch)
B16.3-2006	Malleable Iron Threaded Fittings: Classes 150 and 300
B16.4-2006	Gray Iron Threaded Fittings: (Classes 125 and 250)
B16-5-2009	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
B16.9-2007	Factory-Made Wrought Buttwelding Fittings
B16.11-2009	Forged Fittings, Socket-Welding and Threaded
B16.21-2005	Nonmetallic Flat Gaskets for Pipe Flanges
B18.2.1-2010	Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
B31.1-2010	Power Piping
B31.9-2008	Building Services Piping
B40.100-2009	Pressure Gauges and Gauge Attachments
D.	American Welding Society (AWS):
B2.1/B2.1M-BMG-2009	Base Metal Grouping for Welding Procedures and Performance Qualification
D10.12/D10.12M-2000	Guide for welding Mild Steel Pipe
E.	American Association of State Highway and Transportation Officials (AASHTO):
M300-03	Inorganic Zinc-Rich Primer

- F. Manufacturer's Standardization Society (MSS):
MSS SP 58 Pipe Hangers and Supports-Materials, Design, Manufacture, Selection, Application and Installation
- G. NACE International (NACE):
SP0169-2007 Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- H. National Fire Protection Agency (NFPA):
255-2006 Ed. Test Burning Characteristics of Building Materials

1.10 WARRANTY

The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting there from within a period of two years from final acceptance. Further, the Contractor will provide all manufacturer's and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 PIPING IN EXISTING MANHOLES

- A. Steel Pipes And Fittings
1. Steel Pipe: ASTM A53, Type E, Grade A, wall thickness as indicated below; black with plain ends.
 2. Cast-Iron, Threaded Fittings: ASME B16.4, Class 250, standard pattern.
 3. Malleable-Iron, Threaded Fittings shall be ASME B16.3, Class 300.
 4. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Butt welding.
 - c. Facings: Raised face.
 5. Steel Welding Fittings:
 - a. ASME B16.9, seamless or welded.
 - b. Welding Filler Metals shall comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
 6. Nipples: ASTM A733, Standard Weight, seamless, carbon-steel pipe.
 7. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
 8. Pipe-Flange Gasket Materials: ASME B16.21, suitable for chemical and thermal conditions of piping system contents, nonmetallic, flat, asbestos free, 1/8 inch (3.2 mm) maximum thickness unless thickness or specific material is indicated.

- a. For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. For raised-face, Class 250, cast-iron and steel flanges.
 - B. LP Steam Piping:
 1. NPS 2 (DN 50) and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
 2. NPS 2½ through NPS 12 (DN 65 through DN 300): Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
 - C. HP Steam Piping:
 1. NPS 2 (DN 50) and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
 2. NPS 2½ through NPS 12 (DN 65 through DN 300): Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
 - D. Condensate Piping:
 1. NPS 2 (DN 50) and smaller shall be the following:
 - a. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
 - b. RTRP and RTRF with adhesive or flanged joints.
 2. NPS 2½ (DN 65) and larger shall be Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
- 2.2 PRE-ENGINEERED, FACTORY-FABRICATED, DIRECT-BURIED, DRAINABLE-DRYABLE-TESTABLE (DDT) SYSTEMS
 - A. Pre-engineered Underground Heat Distribution System Design. The manufacturer is responsible for the design of the DDT piping system. This responsibility includes any or all of the following:
 1. Guided and anchor supports.
 2. End seals.
 3. Casing and piping joint closure.
 4. Piping depth and elevation
 5. Piping slope.
 6. Expansion compensation.
 - B. Expansion compensation: The manufacturer is responsible for the system expansion compensation. A detailed stress analysis will be submitted for review as part of the contract requirements.
 - C. Complete steam and condensate piping system with carrier pipes, carrier pipe insulation with jackets and banding, air space, 0.25 inch (6.35 mm) thick steel conduit, conduit insulation and jacket, fusion-bonded epoxy casing coatings, accessories. Do not locate condensate pipes in casings (conduits) that contain steam pipes.

- D. All components of system shall be suitable for carrier pipe pressures and temperatures as follows:
1. Steam System: 150 psi (1000 kPa); 366°F (185°C).
 2. Condensate System: 50 psi (345 kPa); 310°F (154°C).
- E. Minimum Clearance:
1. Between Carrier Pipe Insulation and Conduit: 1 inch (25 mm)
 2. Between Bottom of Carrier Pipe Insulation and Conduit: 1 inch (25 mm)
 3. Between Bottom of Bare, Carrier Pipe and Casing: 1-3/8 inches (35 mm)
- F. Steam Carrier Pipes:
1. No piping joints are allowed in factory-fabricated straight sections of pre-engineered direct-buried systems.
 2. Factory-fabricated direct-buried piping sections that are a portion of an expansion loop or bend shall have all welded joints 100% radiograph inspected.
 3. Pipe: ASTM A53, steel, seamless, Grade B or ASTM A106, Grade B, electric resistance welded or ASTM A53, Grade B, Schedule 40. Standard weight permitted for pipe sizes 12 inches (300 mm) and above. Grade F, furnace butt-welded pipe, is not permitted.
 4. Joints:
 - a. In trenches and direct-buried systems: Butt-weld; socket weld for pipe sizes 2 inches (DN 50) and below. No joints are allowed in factory-fabricated straight sections of pre-engineered direct-buried systems. Factory-fabricated direct-buried piping sections that are a portion of an expansion loop or bend shall have all welded joints 100% radiograph inspected. All radiographs shall be reviewed and interpreted by a American Society for Non-Destructive Testing (ASNT) Certified Level III radiographer, employed by the testing firm, who shall sign the reading report. Dye penetrant testing may be utilized for pipe sizes 2 inches (50 mm) and below.
 - b. In existing manholes and open areas: Butt weld pipe sizes 2½ inches (65 mm) and above; thread or socket weld pipe sized 2 inches (50 mm) and below.
 5. Fittings:
 - a. Butt welded joints: ASTM A234 or ASME B16.9, steel, Grade B, same schedule as adjoining pipe. All elbows shall be long radius unless otherwise indicated. Tees shall be full size or reducing as required, having interior surfaces smoothly contoured.
 - b. Threaded joints: ASTM A47 or ASTM A197 or ASME B16.3, malleable iron, 300 pound (2050 kPa) class.
 - c. Socket welded joints: ASME B16.11, forged steel, 2000 psi (13,800 kPa) class.

6. Flanges and bolts: ASTM A105, pressure class 150 psi (1025 kPa). Bolts shall be high strength ASTM A193, Class 2, Grade B8. Nuts shall be ASTM A194.
 7. Unions: Pipe 2 inches (50 mm) and smaller shall be threaded, malleable iron or steel, 300 psi (2050 kPa) class.
- G. Condensate Carrier Pipes:
1. No piping joints are allowed in factory-fabricated straight sections of pre-engineered direct-buried systems.
 2. Factory-fabricated direct-buried piping sections that are a portion of an expansion loop or bend shall have all welded joints 100% radiograph inspected.
 3. Pipe: ASTM A53, seamless, Grade B or ASTM A106, Grade B or ASTM A53 electric resistance welded, Grade B; Schedule 80. Grade F, furnace butt-welded, pipe is not permitted.
 4. Joints:
 - a. In Trenches and direct-buried systems:
 - 1) Butt weld joints.
 - 2) Socket weld is required for pipe sizes 2 inches (50 mm) and below.
 - 3) Manufacturer's standard sliding, gasketed joints are permitted between factory-fabricated sections of direct buried WSL system. No joints are allowed in factory-fabricated straight sections of pre-engineered direct-buried systems.
 - 4) Factory-fabricated direct-buried piping systems that are a portion of expansion loops or bends shall have all welded joints 100% radiograph inspected.
 - 5) All radiographs shall be reviewed and interpreted by an ASNT Certified Level III radiographer, employed by the testing firm, who shall sign the reading report.
 - 6) Dye penetrant testing may be utilized for pipe sizes 2 inches (50 mm) and below.
 - b. In existing manholes and open areas: Butt weld pipe sizes 2½ inches (65 mm) and above; thread or socket weld pipe sizes 2 inches (50 mm) and below.
 5. Fittings:
 - a. Welded joints: ASTM A234, steel, Grade B, or ASME B16.9, same schedule as adjoining pipe.
 - b. Threaded joints: ASTM A47 or A197, malleable iron, or ASME B16.3, 300 psi (2050 kPa) class.
 - c. Socket welded joints: ASME B16.11, forged steel, 2000 psi (13,800 kPa) class.
 6. Unions (Except in Trenches) are allowed on piping 2 inches (50 mm) and under, 300 psi (2050 kPa) malleable iron or steel.

7. Flanges: Weld neck ASME B16.5 or ASTM A105, forged steel, 150 psi (1025 kPa).

H. Conduit Piping System:

1. Conduit Piping System: Factory-fabricated and assembled, airtight and watertight, drainable, pressure-tested piping with conduit. Fabricate so insulation can be dried in place by forcing dry air through conduit.
2. Conduit shall be spiral wound, steel.
 - a. Finish: Two coats of fusion-bonded epoxy, minimum 20 mils (0.50 mm) thick.
 - b. Polyurethane Foam Pipe Insulation: Un-faced, preformed, rigid cellular polyurethane material intended for use as thermal insulation.
 - 1) Comply with ASTM C591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75°F (24°C) after 180 days of aging.
 - 2) Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1½ inches (38 mm) as tested by ASTM E84.
 - 3) Fabricated shapes: ASTM C450 and ASTM C585.
 - c. Cover: Polyurethane foam insulation with an HDPE jacket.
 - d. Piping Supports within Conduit: Corrugated galvanized steel with a maximum spacing of 10 feet (3 m).
 - e. Fittings: Factory-fabricated and insulated elbows and tees. Elbows may be bent pipe equal to carrier pipe. Tees shall be factory fabricated and insulated, and shall be compatible with the carrier pipe.
 - f. Expansion Offsets and Loops: Size casing to contain piping expansion.
 - g. Accessories include the following:
 - 1) Water Shed: Terminal end protector for carrier pipes entering building through floor, 3 inches (75 mm) deep and 2 inches (50 mm) larger than casing; terminate casing 20 inches (500 mm) above the floor level.
 - 2) Guides and Anchors: Steel plate welded to carrier pipes and to casing, complete with vent and drainage openings inside casing.
 - 3) End Seals: Steel plate welded to carrier pipes and to casing, complete with drain and vent openings on vertical centerline.
 - 4) Joint Kit: Half-shell, pourable or split insulation and shrink-wrap sleeve.
3. Source Quality Control: Factory test the conduit to 15 psi (105 kPa) for a minimum of two minutes with no change in pressure. Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

I. Expansion Loops And Bends

1. Stresses: Less than the maximum allowable stress in the Power Piping Code (ASME B31.1). Submit shop drawings and stress and anchor force calculations for all loops and bends. Show locations of all anchors, guides and supports. Base calculations on 150 psi (1000 kPa) and 366°F (185°C) for steam line loops and bends and 50 psi (345 kPa) and 310°F (154°C) for condensate return line loops and bends. Base calculations on actual pressures and temperatures if they are higher than those listed above.
2. Low pressure steam systems 15 psi (100 kPa) and less: ASME B31.9, base calculations for steam and condensate on 15 psi (100 kPa) and 250°F (121°C).

J. Carrier Pipe Insulation:

1. Conform to minimum thickness listed in Table 1 below as required for service temperature in carrier pipe as listed below.
2. Mineral-Wool Pipe Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, 850°F (454°C) Grade A.
3. Bands shall be ASTM A666, Type 304, stainless steel, 3/4 inch (19 mm) wide, 0.020 inch (0.5 mm) thick.
4. Allowable Carrier Pipe Insulation Type and Minimum Insulation Thickness:

TABLE 1 Minimum Pipe Insulation Thickness mm (inches) For Steam and Condensate 16 to 408 psi (110 to 2800 kPa) gage	
Nominal Pipe Diameter Inches (mm)	Mineral Wool Inches (mm)
1 (25)	1½ (38)
1½ (40)	1½ (38)
2 (50)	1½ (38)
2½ (65)	1½ (38)
3 (80)	1½ (38)
4 (100)	1½ (38)
5 (125)	2 (50)
6 (150)	2 (50)
8 (200)	2 (50)

Notes: Insulation listed has passed the 96-hour boiling water test. Pipes smaller than 1 inch (25 mm) shall have same insulation thickness as 1 inch (25 mm) pipe.

- K. Insulation Banding and Jacket: ASTM A167, stainless steel bands and clips, at least 0.5 inches (13 mm) wide, (304 stainless steel), maximum spacing 18 inches (460 mm). A minimum of two bands is required for each 4 foot (1300 mm) section of insulation.
- L. Casing: ASTM A139, 10 gauge, smooth-wall steel, electric resistance welded. Plastic casings are not permitted. Use eccentric connectors as necessary between casing

sections to provide continuous gravity drainage in bottom of casing between manholes and between manholes and buildings.

- M. Casing End Seal Plates with Vents and Drains: ASTM A36, steel, minimum thickness 0.375 inches (9.5 mm) for casings up thru 12 inches (300 mm) diameter and 0.5 inches (13 mm) for casings over 12 inches (300 mm) diameter. Provide 1 inch (25 mm) drain at the bottom and vent at the top. Construct with threaded steel half couplings. Install threaded brass plugs in drains.
- N. Vent Riser Pipes: ASTM A53, Schedule 40, galvanized, extending through top of existing manhole and terminate 12 inches (300 mm) above grade with 180-degree bend.
- O. Gland Seals are not permitted because of the possibility of water entering the system thru the gland seal from a flooded manhole.
- P. Provide continuous 1 inch (25 mm) minimum air space between carrier pipe insulation and casing.
- Q. Coating of end plates and casing (conduit) sections extending in manholes shall be zinc-rich coating that conforms to AASHTO M300, Type IA except that volatile organic compounds shall not exceed 2.8 pounds per gallon (0.34 kg per liter). The zinc rich coating shall be applied in accordance with the recommendations of the coating manufacturer including surface preparation. No additional top coat shall be applied.
- R. Carrier pipe guides and supports shall be maximum spacing 10 feet (3000 mm) on centers, no more than 5 feet (1500 mm) from pipe ends, minimum of three guides per elbow section. Designed to permit thermal expansion without damage, provide proper pipe guiding and support, and to allow horizontal movement in two directions as necessary at expansion loops and bends. Design of guides and supports must permit continuous drainage of water in bottom of casing. Pipe insulation shall extend thru the pipe guides and supports and be protected by steel sleeves. Design of guides and supports shall be such that no metal-to-metal contact exists between the casing and the carrier pipe. Insulation or non-metallic material used to ensure no metal to metal contact shall be designed to not be compressed by the weight of the carrier pipe when full of water.
- S. Anchor plates shall be ASTM A36 steel, welded to carrier pipe and casing, 0.5 inches (13 mm) minimum thickness, passages for air flow and water drainage thru the annular air space in the system. Coated with same coating material as the casing. Locate 3 to 5 feet (900 to 1500 mm) from piping entrance to manhole or building wall. Walls of manholes and buildings cannot be utilized as anchor points.
- T. Field connection of casing sections shall be steel section conforming to casing specification, welded to casing sections, coated on all surfaces with system manufacturer's coating field repair compound, and covered with a 0.05 inch (1.3 mm) minimum thickness polyethylene shrink sleeve designed for a service temperature exceeding 176°F (80°C).
- U. Manhole and building wall penetrations shall provide steel leak plates welded to wall sleeves or to casings. Where a wall sleeve is utilized, allow sufficient annular space between the sleeve and the casing and install a watertight seal, rated for 250°F (121°C) minimum. Manhole and building walls cannot be used as anchor points.
- V. All branch piping connections must be located in manholes.

- W. Provide embossed brass or stainless steel tag hung by a brass or stainless steel chain at each end of each conduit or insulated piping in the manholes and buildings. The tag shall identify system manufacturer's name, date of installation, government contract, and manufacturer's project number.
- X. Reinforced concrete manholes: Not less than 8 inches (200 mm) thick. Pour monolithically where possible. Place waterproof membrane between mud slab and bottom concrete slab, and continue up sides to top of sidewalls. Joints between manhole walls and conduit casings or concrete trench sections shall be watertight. Steel manholes or prefabricated concrete manholes are not permitted.
- Y. Drainage as required. Provide a 24 inch (610 mm) square by 24 inch (610 mm) deep sump pit in each manhole where required. Provide larger sump pit if necessary to accommodate required electric sump pumps.
- Z. Electric Sump Pumps with Automatic Controls and High Water Alarm:
 - 1. Type: High temperature submersible duplex pumps and automatic controls.
 - 2. Service: Continuous operation at required flows and pressures while completely submerged at 200°F (93°C). All pumps and pump controls shall have demonstrated 200,000 cycles of operation at 200°F (93°C) and 100% relative humidity while totally submerged in water.
 - 3. Capacity and pressure: Pumps shall be capable of passing 0.375 inch (10 mm) spheres. Pumps and motors shall be capable of operating continuously without damage when not submerged.
 - 4. Pumps: Epoxy-coated cast iron casing, cast iron impeller, stainless steel shaft, carbon/ceramic shaft seal, stainless steel hardware, permanently lubricated bearings, screened inlets. Schedule 80 discharge pipe protected from corrosion.
 - 5. Motors: Non-overloading at all points on the pump performance curve. Include overload protection.
 - 6. Controls: Automatic alternating lead-lag, with damp-proof electrical service.
 - 7. High water alarm switch: Set at level below lowest steam or condensate pipe in the manhole. Switch shall activate weatherproof red alarm light mounted above grade. Provide contacts for future connection.

2.3 VALVES

- A. Gate Valves (ASTM A126):
 - 1. Type 101 shall have:
 - a. Cast steel body, rated 150 psi (1025 kPa) at 500°F (260°C), 11½ to 13 percent chromium stainless steel flexible wedge and hard faced (stellite) or nickel copper alloy seats, 150 psi (1025 kPa) flanged ends, OS&Y, rising stem, bolted bonnet.
 - b. Factory installed globe valved bypass on all steam valves larger than 3 inches (80 mm).
 - c. Drill and tap bosses for connection of drains where required.
 - 2. Type 102 is not used.

3. Type 103 shall have cast iron body, Class B, rated for 125 psi (850 kPa) saturated steam, 200 psi (1375 kPa) WOG, bronze or bronze faced wedge and seats, 125 psi (850 kPa) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings.
 4. Type 104 shall have bronze body, rated for 200 psi (1375 kPa) saturated steam, 400 psi (2750 kPa) WOG, bronze wedges and Monel or stainless steel seats, threaded ends, rising stem, union bonnet.
 5. Type 105 is not used.
 6. Type 106 shall have forged steel body, rated for 300 psi (2050 kPa) at 420°F (216°C) minimum Class 600 psi (4130 kPa) or Class 800 psi (5500 kPa), hardened stainless steel or satellite wedge and seats, threaded ends, OS&Y, rising stem, bolted bonnet.
- B. Globe Valves (ASTM A126):
1. Type 201 shall have cast steel body, rated 150 psi (1025 kPa) at 500°F (260°C), 11½ to 13 percent chromium stainless steel or stellite disc and seat, 150 psi (1025 kPa) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings. Drill and tap bosses for connection of drains.
 2. Type 202 is not used.
 3. Type 203 shall have cast iron body, rated for 125 psi (850 kPa) saturated steam, 200 psi (1375 kPa) WOG, bronze or bronze-faced disc (Teflon or composition facing permitted) and seat, 125 psi (850 kPa) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings.
 4. Type 204, in accordance with ASTM B61, bronze body, rated for 200 psi (1375 kPa) saturated steam, 400 psi (2750 kPa) WOG, hardened stainless steel disc and seat, threaded ends, rising stem, union bonnet, renewable seat rings.
- C. Check valves (ASTM A126):
1. Type 401 shall have cast steel body, swing-type, rated for 150 psi (1025 kPa) at 500°F (260°C), stainless steel or stainless steel - faced disc and seat, 150 psi (1025 kPa) ASME flanged ends, bolted cover, renewable disc.
 2. Type 402 is not used.
 3. Type 403 shall have cast iron body, Class B, swing-type, rated for 125 psi (850 kPa) saturated steam, 200 psi (1375 kPa) WOG, bronze or bronze-faced disc and seat, 125 psi (850 kPa) ASME flanged ends, bolted cover, renewable disc and seat.
 4. Type 404 shall have bronze body, swing-type, rated for 200 psi (1375 kPa) saturated steam, 400 psi (2750 kPa) WOG, bronze disc, threaded ends, regrinding disc.
- D. Ball valves (ASTM A126):
1. Type 501 is not used.
 2. Type 502 shall have bronze body, rated for 150 psi (1025 kPa) at 365°F (185°C), 250 psi (1725 kPa) at 250°F (121°C); reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends, one-fourth turn to open.

3. Type 503 is not used.
 4. Type 504 shall have carbon steel or ductile iron body, saturated steam service, rated for 150 psi (1030 kPa), stainless steel ball and stem, Polyfil seat, live-loaded stem seal, 150 psi (1025 kPa) ASME flanged ends. Manufacturer: American, Worcester, or equal.
- E. Butterfly valves (ASTM A126):
1. Type 601 shall have ductile iron body, wafer style, rated for 125 psi (850 kPa), 212°F (100°C), bronze disc, stainless steel stem, EPDM liner, EPDM stem seal and body seal, neck extending beyond pipe insulation, geared handwheel operator for valves 4 inch (100 mm) pipe size and larger, ratchet handle operator for smaller pipe sizes.
 2. Type 602: Triple-offset, lug or flanged type, carbon steel body, steam service, rated for 150 psi (1025 kPa) at 500°F (260°C), stainless steel nitrided disc, stellite seat, stainless steel shaft, stainless steel/graphite-laminated seal ring, neck extending beyond pipe insulation, geared handwheel operator for valves 4 inch (100 mm) pipe size and larger, ratchet handle operator for smaller pipe size valves.
- F. Valve Applications (Steam Lines):
1. Gate valves, 2 inches (50 mm) and under: Type 106.
 2. Gate valves, 2½ inches (65 mm) and above: Type 101.
 3. Globe valves, 2 inches (50 mm) and under: Type 204.
 4. Globe valves, 2½ inches (65 mm) and above: Type 201.
 5. Check valves, 2 inches (50 mm) and under: Type 404.
 6. Check valves, 2½ inches (65 mm) and above: Type 401.
 7. Ball valves, 2 inches (50 mm) and under: Type 502
 8. Ball valves, 2½ inches (65 mm) and above: Type 504.
 9. Butterfly valves, all sizes: Type 602.
- G. Valve Applications (Condensate Lines):
1. Gate valves, 2 inches (50 mm) and under: Type 104.
 2. Gate valves, 2½ inches (65 mm) and above: Type 103.
 3. Globe valves, 2 inches (50 mm) and under: Type 204.
 4. Globe valves, 2½ inches (65 mm) and above:
 5. Type 203. Check valves, 2 inches (50 mm) and under: Type 404.
 6. Check valves, 2½ inches (65 mm) and above: Type 403.
 7. Ball valves, 2 inches (50 mm) and under: Type 502.
 8. Ball valves, 2½ inches (65 mm) and above: Type 504.
 9. Butterfly valves, all sizes: Type 601.

2.4 STEAM TRAPS

- A. Apply at steam line drip points.
- B. Float and thermostatic type.
- C. Fixed orifice or venturi type traps are not permitted.
- D. Traps: Cast iron or stainless steel bodies. Construction shall permit ease of removal and servicing working parts without disturbing connecting piping. Include stainless steel floats, hardened chrome steel valves, stainless steel mechanisms and bi-metallic air vent on inverted bucket traps.
- E. All traps shall include ports for future installation of monitoring devices. To facilitate future removal of plugs, remove plugs, install Teflon tape on the threads, and reinstall the plugs.
- F. Label each trap at the factory with an identification number keyed to the contract drawings. Label shall be a metal tag permanently attached to the trap.

2.5 STRAINERS, Y TYPE

- A. Provide where required on steam and condensate piping systems.
- B. Include open end removable cylindrical screen and threaded blow off connection.
- C. For steam service up to 150 psi (1025 kPa) and at drip traps, strainer shall be rated for minimum 150 psi (1025 kPa) saturated steam; rated for 150 psi (1025 kPa), flanged ends, cast steel, for pipe sizes above 2 inches (50 mm). Use cast iron or bronze, rated for 250 psi (1725 kPa) saturated steam, threaded ends, for pipe sizes 2 inches (50 mm) and under.
- D. For condensate service, strainer shall be rated for 125 psi (850 kPa) saturated steam, 175 psi (1200 kPa) WOG. Provide 125 psi (850 kPa), flanged ends, cast iron, for pipe sizes above 2 inches (50 mm). Provide cast iron or bronze, threaded ends, for pipe sizes 2 inches (50 mm) and under.
- E. Strainer screen shall be stainless steel, with a free area not less than 2½ times flow area of pipe. Diameter of openings shall be 0.05 inch (1.3 mm) or less on steam service and 0.06 inch (1.5 mm) or less on water service.
- F. Include gate type valve and quick couple hose connection on all blowoff connections.

2.6 PRESSURE GAGES

- A. Provide gages immediately downstream of each steam line isolation valve, before and after each steam pressure reducing station and where shown on the drawings.
- B. Gages: ASME B40.100
 - 1. Solid armored front between measuring element and dial, blowout back, bottom connection, phenol turret type.
 - 2. Non corrosive, 4½ inch (110 mm) diameter face with black markings on white background.
 - 3. Bourdon tube measuring element designed for service. Provide bellows for pressure ranges under 15 psi (100 kPa).
 - 4. Stainless steel, rotary movement.

5. Micrometer adjustable, black color pointer.
 6. Plastic window.
 7. Provide liquid filled gages at outlet of all pumps.
- C. Accuracy: Grade 2A, 1/2 percent, on all gages; except Grade A, one percent permitted on diaphragm actuated gages, liquid filled gages, and compound gages.
- D. Include:
1. Red set hands on gages located at automatic pressure regulator valve outlets.
 2. Needle valve or gage cock rated for the service.
 3. Syphon on all steam gages.
 4. Overload stop on all pressure gages.
- E. Except where otherwise shown on the drawings, pressure ranges shall be as follows:

SERVICE	RANGE
Steam to 15 psi (100 kPa)	0 to 30 psi (0 to 200 kPa)
Steam to 59 psi (407 kPa)	0 to 100 psi (0 to 700 kPa)
Steam above 59 psi (407 kPa)	0 to 200 psi (0 to 1500 kPa)
Condensate Pump Discharge	0 to 100 psi (0 to 700 kPa)
Vacuum Return	30 inches HG 0 - to 15 psi (100 kPa vacuum to 100 kPa)

2.7 PIPE HANGERS AND SUPPORTS

- A. Requirements: MSS SP 58 and ASME B31.1.
- B. Applies to all piping not in factory-fabricated direct-buried system. All systems shall be completely supported. Arrange supports so that all loads due to weight, thermal expansion, seismic shock (if applicable), and pressure are transferred from the support system to the structure. The design and location of supports shall at all times prevent excessive forces, moments, and stresses from being imposed on the equipment, structure, supported system, and supports. Heated systems generally require resilient or roller/slide supports.
- C. Manufacturer Certification: Factory built products of a manufacturer whose principle business is pipe supports for 5 years. All components must have published load ratings. For concrete trenches, non-factory built products that comply with details may be utilized.
- D. Drawings:
1. Types, sizes, locations, and spacing of all hangers and supports.
 2. Roller or slider supports for all horizontal steam and condensate piping.
 3. Special supports including anchors, guides and braces.
 4. If equipment and piping arrangement differs from that shown on the drawings, support locations and types shall be revised at no cost to the government.

5. Supports to permit removal of valves and strainers from pipelines without disturbing supports.
 6. Spring hangers on all systems subject to vertical movement.
 7. Roller hangers and sliding supports on all systems subject to horizontal movement.
 8. If vertical angle of hanger rod exceeds four degrees, rollers or sliders are required.
 9. Individual drawing for each hanger assembly showing all components, sizes, calculated loadings. Provide identification tags, on each hanger part, keyed to the layout drawings.
- E. Roller supports: MSS SP 58, Type 41, 43, and 46. Provide vertical adjustment for Type 41 with threaded studs and nuts adjacent to the roller.
- F. Clevis supports: MSS SP 58, Type 1.
- G. Wall brackets: MSS SP 58, Type 31, 32 or 33, as applicable.
- H. Pipe stands: MSS SP 58, Type 38.
- I. Riser clamp: MSS SP 58, Type 42.
- J. Alignment guides: Welded steel to restrain movement perpendicular to the long axis of the piping. If not welded, provide steel spider clamped to pipe, enclosed within steel sleeve that is bolted or welded to structural support. Must provide lateral force equal to minimum of 15 percent of anchor loading.
- K. Trapeze supports: MSS SP 58, may be used where pipes are close together and parallel, structural steel channels or angles. Bolt roller supports to steel to support piping subject to horizontal thermal expansion. Attach other piping with "U" bolts.
- L. Pipe covering protection saddles: MSS SP 58, Type 39. Provide at all support points on insulated pipe except where Type 3 pipe clamp is provided.
- M. Sliding supports: MSS SP 58, Type 35. Welded steel attachments to pipe and structure with Teflon or graphite sliding surfaces bonded to the attachments. Provide steel guides, except at expansion bends, to prevent lateral movement of the pipe.
- N. Pipe racks and miscellaneous supports: ASTM A36, structural steel shapes. Manufactured strut systems are acceptable if they have the required load carrying ability.
- O. Supports, including all structural steel, in trenches and manholes: Hot-dip galvanized.
- P. Seismic Restraints:
1. Provide bracing as required.
 2. Shock Absorbers: MSS SP 58, Type 50. Mechanical or hydraulic type rated for shock loads. Pipe attachments shall be MSS SP 58, Type 3.
 3. Insulation Materials (In Manholes, Open Areas)
- Q. Fiberglass Insulation:
1. Preformed piping insulation: ASTM C547, 450°F (230°C).

2. Fitting insulation: ASTM C547, 450°F (230°C), with polyvinyl chloride, Type II Grade GU, and Type III, premolded fitted covering 0.020 inches (0.5 mm) thick.
- R. Insulating and finishing cements: ASTM C449, as recommended by the manufacturer for the type of insulation system and service conditions.
- S. Insulation bands: ASTM A167, minimum of 1/2 inch (12 mm) wide by 0.015 inch (0.4 mm) thick stainless steel.
- T. Aluminum jackets: Minimum of 0.016 inch (0.4 mm) thick aluminum, 3003 alloy, H-14 temper, with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory fabricated to match material and construction of the straight run jackets. Factory fabricated stainless steel bands shall be furnished and installed on all circumferential joints. Bands shall be 0.75 inch (20 mm) wide on 18 inch (450 mm) centers. Bands shall be applied with manufacturers recommended sealant. Entire system shall be watertight.
- U. Service jackets: ASTM C1136, white kraft bonded to 0.001 inch (0.025 mm) thick aluminum foil, fiberglass reinforced, pressure sensitive adhesive closure, beach puncture tested to 50 units, suitable for painting without sizing. Jackets shall have a minimum 1½ inch (40 mm) lap on longitudinal joints and not less than 4 inch (100 mm) butt strips on end joints. Butt strip material shall be same as the jacket. Lap and butt strips may be self-sealing type with factory-applied pressure sensitive adhesive.
- V. Glass cloth jacket: A minimum 7.8 ounces per square yard (0.24 kg per square meter), 300 psi (2000 kPa) bursting strength, weathertight for outside service. Beach puncture test to 50 units.
- W. Pipe covering protection saddles: MSS SP 58, Type 39 at all hanger points except where Type 3 pipe clamps are provided.
- X. Fire and smoke ratings of assembled insulation systems: ASTM C411 and NFPA 255, flame spread (25) and smoke developed (50) ratings.

2.8 BURIED UTILITY WARNING TAPE

Tape: 0.004 inch (0.1 mm) thick, 6 inches (150 mm) wide, yellow polyethylene with a ferrous metallic core, acid and alkali-resistant and shall have a minimum strength of 1750 psi (12,000 kPa) lengthwise and 1500 psi (10,300 kPa) crosswise with an elongation factor of 350 percent. Provide bold black letters on the tape identifying the type of system. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material.

PART 3 - EXECUTION

3.1 GENERAL

- A. If the carrier pipe insulation has failed (disintegrated) in an existing buried piping system, but the system is otherwise sound, there is an alternative to total replacement of injecting foam insulation into the existing system from above grade.
- B. Connect new work to existing work in a neat and workmanlike manner. Where an existing structure must be cut or existing utilities interfere, such obstruction shall be bypassed, removed, replaced or relocated, patched and repaired. Piping connections shall be made only in manholes or buildings.

- C. Coordinate the location of all items of equipment and work of all trades. Maintain operability and maintainability of the equipment and systems. The contractor at his cost shall perform any relocation of equipment or systems to comply with the requirement of operability and maintainability.
- D. Unless otherwise shown on drawings, steam lines shall be graded downward not less than 2 inches in 40 feet (50 mm in 12 meters) in direction of the flow. Provide eccentric reducing fittings on steam mains and branches, (except on vertical piping). Install said fittings to maintain continuity of grade in bottom of pipeline. Provide risers with drip pockets and steam traps on steam lines where space restrictions prevent continuous grading. All steam traps must be located in manholes.

3.2 DEMOLITION

- A. Perform work in accordance with requirements for phasing and the Drawings.
- B. Completely remove all pipe, valves, fittings, insulation, and all hangers including the connection to the structure and any fastenings.
- C. Seal all openings in manhole or building walls after removal of piping.
- D. All material and equipment removed shall become the property of the Contractor and shall be removed from Government property and shall not be stored in operating areas.
- E. All flame cutting shall be performed with adequate fire protection facilities available as required by safety codes and COR.

3.3 PIPING INSTALLATION

- A. Drawings indicate general location and arrangement of piping systems. Install piping insulation as indicated.
- B. Standing water in the bottom of trench: Remove all water.
- C. Pipe Bedding: Minimum 6 inch (150 mm) layer of sand.
- D. Clearance: Minimum 6 inch (150 mm) clearance between the pipes.
- E. Testing: Do not insulate piping or backfill piping trench until field quality-control testing has been completed and results approved.
- F. Grade:
 - 1. Install condensate piping at uniform grade of 0.4 percent downward in direction of flow.
 - 2. Install piping at uniform grade of 0.2 percent downward in direction of flow.
- G. Drain Valves and Air Vents: In conduits, install at low points and air vents at high points.
- H. Install components with pressure rating equal to or greater than system operating pressure.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Secure anchors with concrete thrust blocks.
- L. Connect to steam and condensate piping where it passes through the building wall.

3.4 DRAIN VALVES AND VENT VALVES

Provide 1½ inch (40 mm) minimum pipe size drain valves on condensate return carrier pipes at all low points in manholes. Provide 1 inch (25 mm) minimum air vent valves in manholes at all high points in condensate return carrier piping.

3.5 PIPE SUPPORT INSTALLATION (MANHOLES)

- A. Coordinate support locations prior to erection of piping. Hanger parts must be marked at the factory with a numbering system keyed to hanger layout drawings. Layout drawings must be available at the site during construction.
- B. Upper Attachments to Structure:
 - 1. New reinforced concrete construction shall have concrete inserts.
 - 2. For existing reinforced concrete construction, upper attachment shall be welded or clamped to steel clip angles (or other construction if shown on the drawings) that are expansion bolted to the concrete. Expansion bolting shall be located so that loads place bolts in shear.
 - 3. For steel deck and structural framing, upper attachments shall be welded or clamped to structural steel members.
- C. In existing concrete construction, expansion fasteners may be used for hanger loads up to one third the manufacturer's rated strength of the expansion fastener. Power set fasteners may be used for loads up to one fourth of rated load. When greater hanger loads are encountered, additional fasteners may be used and interconnected with steel members combining to support the hanger.
- D. Special Supports:
 - 1. Secure horizontal pipes where necessary to prevent vibration or excess sway.
 - 2. Where hangers cannot be adequately secured as specified, make special provisions for hanging and supporting pipe as approved by the COR.
 - 3. Do not attach pipe supports, hangers, clamps or anchors to equipment unless specified for that equipment or unless the COR gives written permission.
- E. Locate spring hanger units within 1 foot (300 mm) of the pipe attachment, except in locations where spring assemblies interfere with pipe insulation.
- F. Seismic Braces and Restraints: Do not insulate piping within 1 foot (300 mm) of device until device has been inspected by COR.
- G. Minimum Clearances in Trenches:
 - 1. Floor to bottom of pipe support beam: 2 inches (50 mm)
 - 2. Floor to bottom of pipe insulation jacket: 6 inches (150 mm)
 - 3. Wall to side of pipe insulation jacket: 3 inches (75 mm)
 - 4. Ceiling to top of pipe insulation jacket: 1 inch (25 mm)

3.6 PRE-ENGINEERED, FACTORY-FABRICATED, DIRECT-BURIED, DRAINABLE-DRYABLE-TESTABLE (DDT) SYSTEM INSTALLATION

- A. The Contractor shall oversee the deliver, store, install and test the system as per manufacturer's recommendations. All work shall be in strict accordance with the

requirements specified by the manufacturer. Printed instructions must be available on site prior to delivery of system components. Any changes required to the design and layout of the system due to site conditions must be approved in writing by the COR. All branch piping connections, valves and drip traps must be located within manholes.

- B. Excavation, Trenching, and Backfilling: Perform all excavation, trenching, and backfilling as required by the system manufacturer's design. Beach sand or any sand with large amounts of chlorides is not permitted. Place system on a 6 inch (150 mm) thick sand bed and backfill on all sides with 6 inch (150 mm) thick sand as measured from outside the carrier pipe/insulation. Foundation for system must be firm and stable. Foundation and backfill must be free from rocks. Concrete anchor and thrust blocks must be installed in undisturbed earth. Backfilling must not commence until elevations have been surveyed and accepted and system has been satisfactorily pressure tested including hydrostatic testing of carrier pipes and air testing of casings.
- C. Maintain constant slope of carrier pipes as specified. Prior to backfilling over the top of the casing, but after removal of temporary supports, Contractor shall measure and record elevations of top of casing in the trench. Elevations shall be taken at every field joint, 1/3 points along each pipe section, and at tops of elbows. These measurements shall be checked against contract drawings and shall confirm that the conduit system has been installed to the elevation requirements of the manufacturer and as approved by the COR. Slope shall be uniform within 0.1 percent. Measurements shall be recorded by the Contractor, included in the direct buried system manufacturer representative's daily report, and given to the COR prior to covering the top of the casing with backfill.
- D. Remove all dirt, scale, and other foreign matter from inside the piping by use of a pipe swab or pipe "pig" before connecting pipe sections, valves, or fittings.
- E. Sections of system that have been fully or partially submerged in water must be replaced. Moisture content of insulation during installation shall not exceed five percent by weight.
- F. At each casing termination (end plate) in buildings and manholes, plug the casing drain openings with brass plugs and extend 1 inch pipe size galvanized vent pipes (ASTM A53) from the casing vents through the tops of the manholes or 1 foot (300 mm) above the conduit in buildings. Terminate the outside vents in 180-degree bends.
- G. Provide reports to the COR that include:
 - 1. Daily written report: Prepared daily and signed by the Contractor. Submit the original report to the COR on the same day it is prepared. Provide one set of field pictures of work daily.
 - 2. Report Contents: State whether or not the condition and quality of the materials used and the delivery, storage, installation and testing of the system are in accordance with the manufacturer's recommendations, changes to drawings and specifications, any corrective action that was taken of the system, identify any conditions that could result in an unsatisfactory installation.
 - 3. Report Certification: Daily reports are to be reviewed, signed and sealed by the Professional Engineer responsible for the system installation.

4. Report Submittals and Stop Order: Daily reports shall be submitted with the payment requests. All work must stop if daily reports are not furnished and requests for payments shall be denied if the daily reports are not furnished.
 5. Certification of Compliance: Upon completion of the work and 30 days prior to final acceptance, deliver to COR a notarized Certificate of Compliance signed by principal officers of Contractor, stating that the installation is satisfactory and in accordance with plans, specifications, and manufacturer's instructions.
 6. The Contractor shall retain copies of all the daily reports and the Certificate of Compliance for 5 years after final acceptance of the system by the Government.
- H. Sections of system that have been fully or partially submerged in water must be replaced. Moisture content of insulation during installation shall not exceed five percent by weight.
- I. At each casing termination (end plate) in buildings and manholes, plug the casing drain openings with brass plugs and extend 1 inch pipe size ASTM A53 galvanized vent pipes from the casing vents through the tops of the manholes or 1 foot (300 mm) above the conduit in buildings. Terminate the outside vents in 180-degree bends.

3.7 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded joints: ASME B1.20.1, tapered pipe threads. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified. Joints made with oil and graphite pipe joint compound shall have compound applied to male threads only.
 2. Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 3. Pipe threads shall be cut to give proper engagement in threaded fittings. Clean pipe and fittings before installation and ream pipe after cutting threads. Threaded pipe shall have clean-cut threads; dull or damaged pipe dies shall not be used.
- D. Construct welded joints: AWS D10.12, using qualified processes and welding operators according to "Quality Assurance" Article. Branch connections shall be made with either welding tees or welding outlet fittings. Welding outlet fittings shall be forged, integrally reinforced to provide 100 percent pipe strength, beveled for full penetration welding and funneled at inlet for full fluid flow.
- E. Flanged joints: Select gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Gaskets and bolting shall be applied in accordance with the recommendations of the gasket manufacturer and bolting standards of ASME B31.1. Strains shall be evenly applied without overstress of bolts. Gaskets shall cover entire area of mating faces of flanges.

- F. Location, spacing and cold set of ball joints: Conform to layout drawings approved by manufacturer of ball joints. Representative of manufacturer shall visit site and verify that installation is proper. Locate to allow access to all packing injection devices, when provided.
- G. Expansion Joints (Bellows And Slip Type):
 - 1. Type, quantity and spacing of anchors and guides as recommended by manufacturer of expansion joint. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments that will be imposed.
 - 2. Cold setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.
 - 3. Prepare for service by cleaning all sliding surfaces, add packing as necessary. Remove all apparatus provided to restrain joint during shipping or installation.
 - 4. Expansion joints must be located in readily accessible manhole. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding packing.
- H. Conduit piping joints shall be assembled in sections and finished with pourable or split insulation, exterior jacket sleeve, and apply shrink-wrap seals.
- I. All pipe intersections and changes in direction shall be made with factory-built-reinforced fittings. Field-fabricated fittings and miters are not permitted.

3.8 INSTALLATION - PRESSURE GAGES

Locate at inlet and outlet of each pressure reducing station, on each pump discharge and after main stop valves (gate and butterfly valves) on steam distribution lines. Orient gages so that dials are upright and visible from nearest walkway and from operating point of main steam stop valves. Provide gage cock. Provide siphon on steam service. Provide liquid filled gages on pump discharge.

3.9 INSTALLATION – THERMOMETERS

Orient thermometers so that scales are upright and visible from nearest walkway. Locate wells in flow stream.

3.10 INSTALLATION – VALVES

- A. Do not locate valve stems below the horizontal centerline of the pipe.
- B. Locate valves to permit access for operation, maintenance, and replacement.
- C. Provide 3/4 inch (19 mm) globe-valved warm-up bypasses at all steam gate and butterfly valves 3 inch (80 mm) pipe size and larger.
- D. Provide 3/4 inch (19 mm) gate or ball-valved drains at each side of steam gate and butterfly valves where condensate could collect, due to the slope of the pipeline, when the main valve is shut.

3.11 THERMAL INSULATION FOR PIPING IN MANHOLES

- A. Steam, condensate and drip return piping, other than in pre-engineered direct buried systems, shall be insulated as follows:

1. Piping in manholes: Insulated with fiberglass, or cellular glass pipe insulation, glass cloth or aluminum jacket.
2. Minimum Insulation Thickness: See Section 23 07 11, HVAC AND BOILER PLANT INSULATION.
3. Parts not to be insulated are:
 - a. Threaded valves
 - b. Steam traps
 - c. Check valves
 - d. Unions
 - e. Threaded strainers
 - f. Strainer basket removal cover and bolting
 - g. Dielectric flanges and unions
 - h. Expansion joints
 - i. Flexible connectors
 - j. Ball joints except piping between joints
4. Installation of insulation:
 - a. Pressure Tests: Complete all pressure tests before installing.
 - b. Insulation material: New, clean, dry and stored in a clean dry environment; jacketing materials to be clean and unmarred; store adhesives in original containers. Materials shall not have exceeded the predicted shelf life as set by manufacturer.
 - c. Identify all materials incorporated in the job on manufacturer's container by name, type and description.
 - d. Apply materials on clean, dry surfaces from which all dirt, loose scale, construction debris has been removed by wire brushing.
 - e. The installation shall be neat, thermally and structurally tight without sag, neatly finished at all hanger or other penetrations and shall provide a smooth finished surface primed as required to receive specified painting.
 - f. Do not use scrap insulation. Repair any work damaged by welding, burning, compressing due to concentrated construction loads.
 - g. Apply pipe covering protection saddles, MSS SP 58, Type 39, at all hanger points. Fill space between saddle and piping with high density insulation, thoroughly packed. Terminate jacket clear of saddle bearing area.
 - h. Insulation and jacket shall terminate hard and tight at all anchor points.
 - i. Insulation termination at piping facilities not to be insulated shall stop short, and be finished with 45 degree chamfered section of insulating and finishing cement, and covered with jacket.

- j. Flanged fittings and valves shall be insulated with sections of pipe insulation cut, fitted and arranged neatly, and firmly wired in place. Insulating cement shall fill all cracks, voids and outer surface for covering with glass cloth. Insulation of valve bonnet shall terminate on valve side of bonnet flange to permit valve repair.
- k. Fiberglass insulated piping systems fittings over 2 inches (50 mm) shall be insulated with specified molded pipe fitting insulation or compressed blanket, finished with specified insulating and finishing cements and covered with specified PVC fitting jacket. On sizes 2 inches (50 mm) and under apply insulating and finishing cements and cover with PVC fitting jacket.
- l. Apply glass cloth jacket using an approved adhesive. Glass cloth shall be smooth, tight and neatly finished at all edges; prime cloth to receive paint.

3.12 WELDING (ASME B31.1 AND AWA B2.1-B)

- A. The Contractor is entirely responsible for the quality of the welding and shall:
 - 1. Conduct tests of the welding procedures used on the project, verify the suitability of the procedures used, verify that the welds made will meet the required tests, and also verify that the welding operators have the ability to make sound welds under standard conditions.
 - 2. Perform all welding operations required for construction and installation of the distribution system.
- B. Welder Qualifications: All welders shall be qualified as per ASME B31.1 and AWS B2.1/B2.1M-BMG.
- C. Field bevels and shop bevels: Done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding. Conform to specified standards.
- D. Utilize split welding rings or approved alternate method for field joints on all carrier pipes above 2 inches (50 mm) to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe. Make field joints 2 inches (50 mm) and smaller with welding sockets.
- E. Piping shall not be split, bent, flattened, or otherwise damaged either before, during, or after installation. Where the pipe temperature falls to 32°F (0°C) or lower, the pipe shall be heated to approximately 100°F (38°C) for a distance of 1 foot (300 mm) on each side of the weld before welding, and the weld shall be finished before the pipe cools to 32°F (0°C).
- F. Replace and reinspect defective welds. Repairing defective welds by adding weld material over the defect or by peening will not be permitted. Welders responsible for defective welds must be requalified.
- G. Electrodes shall be stored in a dry heated area, and be kept free of moisture and dampness during fabrication operations. Discard electrodes that have lost part of their coating.
- H. An approved independent testing firm regularly engaged in radiographic testing shall perform radiographic examination of all field welds in the carrier piping of the systems, in manholes, in accordance with ASME B31.1. Furnish a set of films or pictures

showing each weld inspected, a report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project, prior to installing conduit field joints, trench covers, backfilling and hydrostatic testing. All radiographs shall be reviewed and interpreted by an ASNT Certified Level III radiographer, employed by the testing firm, who shall sign the reading report. The COR reserves the right to review all inspection records, and if any welds inspected are found unacceptable they shall be removed, rewelded, and radiographically reexamined at no cost to the Government.

3.13 CLEANING OF PIPING:

Clean pipe and fittings inside and outside before and after assembly. Remove all dirt, scale, and other foreign matter from inside the piping by use of a pipe swab or pipe "pig" before connecting pipe sections, valves, equipment or fittings.

3.14 IDENTIFICATION

Install continuous plastic underground warning tapes during back filling of trenches for underground steam and condensate distribution piping. Locate tapes 12 inches (300 mm) below finished grade, directly over piping.

3.15 IDENTIFICATION SIGNS

- A. Valves: Provide laminated plastic signs, with engraved lettering not less than 3/16 inch (5 mm) high, on all isolating valves on steam and condensate return system, identifying building or area served. Attach to the valves with corrosion-resistant chains.
- B. Pipes: Label service of all pipes in existing manholes.

3.16 FIELD QUALITY CONTROL

- A. Demonstrate leak-tightness of all piping systems by performing hydrostatic and operational tests. All labor, material and test instruments must be furnished by the Contractor. All instruments must be approved by the COR.
- B. Pressure test direct-buried systems in conformance with requirements stated in this specification and in printed instructions for the system supplied. Tests must include carrier piping and casing.
- C. Holiday testing of direct-buried system steel casings: Test entire surface of casings for faults in coating after installation in trench prior to backfilling. Use test method and voltage recommended by coating manufacturer. Repair any holidays found and retest. System shall not be backfilled until all holidays are eliminated.
- D. Before conducting steam system operating test, remove steam trap elements or use bypass connections around traps; then flush lines with high pressure water until discharge shows no foreign matter to the satisfaction of COR.
- E. Steam and condensate carrier piping shall be tested hydrostatically before insulation is applied at field joints and shall be proved tight at a pressure 1½ times distribution supply pressure for a period not less than 2 hours with no pressure decay.
 - 1. Test piping located in concrete trenches prior to installing trench covers. Test direct-buried systems prior to backfilling.
 - 2. Remove or isolate any elements of the system such as expansion joints, which are not designed for the test pressure.

3. Prior to acceptance of installation, Contractor shall subject system to operating tests as may be required by COR to demonstrate satisfactory functional and operating efficiency. These operating tests shall cover a period of not less than six hours for each portion of system tested. Conduct tests at times as the COR may direct.
 4. Provide calibrated instruments, equipment, facilities and labor, at no additional cost to the Government. Test gage shall read in increments not exceeding 0.1 psi (1 kPa).
 5. Repeat tests when failures occur.
 6. After completion of satisfactory test, replace all elements that have been removed prior to testing.
- F. Pneumatic Testing of DDT System Casings:
1. Perform test on all sections of the system before field-coating the field joints and before back-filling.
 2. Test shall be with compressed air at 15 psi (100 kPa) for 24 hours with pressure source disconnected and with no decay in pressure. Corrections to the readings are permissible to compensate for significant ambient temperature changes during the test period.
 3. Pressure shall be measured with a gage with reading increments of 0.1 psi (1 kPa).
 4. Each casing field joint shall be tested for leaks by means of soap solution or equivalent.
- G. NACE-accredited corrosion specialist shall test cathodic protection systems and demonstrate proper operation and protection in accordance with the recommendations and criteria in NACE SP0169.
- H. Deficiencies discovered shall be corrected at the Contractor's expense, to satisfaction of COR. Major deficiencies or failure to correct deficiencies, to the satisfaction of the COR, may be considered cause for rejecting the entire installation.
- I. Contractor will engage a qualified testing agency to perform tests and inspections.
- J. Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations for the system.
- K. Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- L. Tests and Inspections:
1. Steam and condensate piping for testing: ASME B31.1 and ASME B31.9 and as follows:
 - a. Leave joints, including welds, uninsulated and exposed for examination during test.
 - b. Isolate equipment. Do not subject equipment to test pressure.

- c. Install relief valve set at pressure no more than one-third higher than test pressure.
 - d. Fill system with temperature water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
 - e. Use vents installed at high points to release trapped air while filling system. Use drip legs installed at low points for complete removal of liquid.
2. Test steam and condensate piping as follows:
 - a. Subject steam and condensate piping to hydrostatic test pressure that is not less than 1.5 times the design pressure.
 - b. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.
 3. Test Conduit: Seal vents and drains and subject conduit to 15 psi (105 kPa) for four hours with no loss of pressure. Repair leaks and retest as required.

-- End of Section --