

Steam Distribution Replacement Project  
Phase 4

V.A. Medical Center  
Sheridan, Wyoming  
Project No. 666-12-111

WPE # BR11010  
June 9, 2011

## ATTACHMENT 2

### TABLE OF CONTENTS

	SPECIFICATIONS	
	<b>DIVISION 1 - GENERAL REQUIREMENTS</b>	
01 00 00	General Requirements	09-08M
01 33 23	Shop Drawings Product Data and Samples	10-07M
01 57 19	Temporary Environmental Controls	10-07M
01 74 19	Construction Waste Management	05-06M
	<b>DIVISION 7 - THERMAL AND MOISTURE PROTECTION</b>	
07 11 13	Bituminous Dampproofing	10-07M
	<b>DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING</b>	
23 05 11	Common Work Results for HVAC and Steam Generation	04-04M
23 22 13	Steam and Condensate Heating Piping	12-06M
	<b>DIVISION 26 – ELECTRICAL</b>	
26 42 00	Cathodic Protection	08-04M
	<b>DIVISION 31 – EARTHWORK</b>	
31 20 11	Earth Moving (Short Form)	09-04M
	<b>DIVISION 32 – EXTERIOR IMPROVEMENTS</b>	
32 05 23	Cast-In-Place Concrete	12-05M
32 12 16	Asphalt Concrete Paving	11-05M
	<b>DIVISION 33 – UTILITIES</b>	
33 63 00	Steam Energy Distribution	06-04M
	<b>DRAWINGS</b>	
<b>SHEET NO.</b>	<b>TITLE</b>	
T1	Title Sheet and Drawing Index	
15.1	Existing Site Plan	
15.2	Renovation Site Plan	
15.3	Enlarged Scale Section ‘E’ - NOT IN THIS CONTRACT	
15.4	Enlarged Scale Section ‘F’ - NOT IN THIS CONTRACT	
15.5	Enlarged Scale Section ‘D’	
15.6	Enlarged Scale Section ‘B’ - NOT IN THIS CONTRACT	
15.7	Enlarged Scale Section ‘A’	
15.8	Enlarged Scale Section ‘C’ - NOT IN THIS CONTRACT	
15.9	Enlarged Scale Section ‘G’	
15.10	Mechanical Schedules & Details	

# SPECIFICATIONS

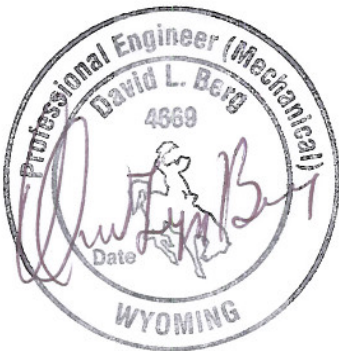
FOR

**Steam Distribution Replacement  
Project - Phase 4**

**V.A. Medical Center  
Sheridan, WY**

**Project No. 666-12-111**

David L. Berg, P.E.  
Mechanical Engineer



6-9-2011

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

TABLE OF CONTENTS

1.1	GENERAL INTENTION .....	1
1.2	STATEMENT OF BID ITEM(S) .....	1
1.3	SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR .....	1
1.4	CONSTRUCTION SECURITY REQUIREMENTS .....	2
1.5	CONSTRUCTION SAFETY REQUIREMENTS .....	2
1.6	FIRE SAFETY .....	3
1.7	OPERATIONS AND STORAGE AREAS .....	5
1.8	ALTERATIONS .....	8
1.9	DISPOSAL AND RETENTION .....	9
1.10	PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS .....	10
1.11	RESTORATION .....	11
1.12	LAYOUT OF WORK .....	12
1.13	USE OF ROAD WAYS .....	12
1.14	AVAILABILITY AND USE OF UTILITY SERVICES .....	12
1.15	RELOCATED EQUIPMENT/ITEMS .....	12
1.16	AS-BUILT DRAWINGS .....	13
1.17	INSTRUCTIONS .....	13
1.18	HISTORIC PRESERVATION .....	14
1.19	RECYCLING MATERIAL .....	14

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

**1.1 GENERAL INTENTION**

- A. Contractor shall furnish labor and materials and perform work as required by drawings and specifications.
- B. Visits to the site by Bidders may be made only by appointment with the Medical Center Facilities Management Engineering Office
- C. All employees of general contractor and subcontractors shall comply with VA security management program and be restricted from unauthorized access. Contractors must obtain Contractor I.D. badges from Facility Management Services (FMS) prior to commencement of work. A valid state or government issued Photo ID is required for each individual applying for an I.D. badge.
- D. Prior to commencing work, general contractor shall provide proof that a OSHA certified "competent person" (CP) (29 CFR 1926.20(b)(2)) will maintain a presence at the work site whenever the general or subcontractors are present.
- E. The VA Engineering Office, 1898 Fort Road, Building 5, room 208, Sheridan, WY 82801, will render certain technical services during construction. Such services shall be considered as advisory to the Project 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.

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

- A. Item A: Scope includes all necessary labor and materials required to replace underground steam and condensate piping in Section "A" as per the drawings and specifications.
- B. Item G: Scope includes all necessary labor and materials required to replace underground steam and condensate piping in Section "G" as per the drawings and specifications.
- C. Item D: Scope includes all necessary labor and material required to replace underground steam and condensate piping in Section "D" as per the drawings and specifications.

**1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR**

- A. AFTER AWARD OF CONTRACT, 3 sets of specifications and drawings will be furnished to the general contractor.
- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense.

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

##### **A. 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. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.
2. Regular working hours shall be limited to 7:30 am to 5:00 pm with no work on weekends or Federal Holidays. For working outside the "regular hours" as defined in the contract, The General Contractor shall get approval from Contracting Officer and 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.

##### **B. Document Control:**

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

##### **C. Key Control:**

1. The General Contractor shall provide duplicate keys and lock combinations to the COTR for the purpose of security inspections of every area of project including tool boxes and parked machines to provide access for emergency action.

#### **1.5 CONSTRUCTION SAFETY REQUIREMENTS**

##### **A. Safety Submittals Required Prior To Commencing Work and/or Notice To Proceed:**

1. The contractor will designate a competent person (CP) to serve as the sole point of contact responsible for safety management on the

project site. Competent persons are defined as those capable of identifying existing and predictable hazards in the surroundings and working conditions which are unsanitary, hazardous, or dangerous, and who have the authority to take prompt corrective measures to eliminate them. This CP designation is a formal, required submittal that requires approval by the contracting officer's technical representative (COTR).

2. The contractor will submit proof of 30-hour OSHA safety course (i.e., copies of documentation) for prime contractor-designated competent persons as well as any subcontractor-designated competent persons that will work on the site. This proof is a formal, required submittal that requires approval by the contracting officer's technical representative (COTR).
3. The contractor will submit proof of 10-hour OSHA safety course (i.e., copies of documentation) for all other prime contractor employees as well as any subcontract employees that will work on the site. This proof is a formal, required submittal that requires approval by the contracting officer's technical representative (COTR).
4. Submittals must include the names, qualifications, and training dates for the prime contractor-designated competent person (CP) designated to administer the site-specific safety program, as well as the CP (if different) for high risk activities as required by OSHA regulations, such as scaffolding, crane operations, excavations, trenching, etc.
5. Federal acquisition regulation (FAR) 52.236-13, with alternate 1, requires submittal and approval of a safety plan, specific to the project and to the construction site. The contractor will submit a safety plan that includes detailed safety precautions and practices to mitigate identified hazards specific to this project and to this construction site. This plan is a formal, required submittal that requires approval by the contracting officer's technical representative (COTR).

#### **1.6 FIRE SAFETY**

A. Applicable Publications: Publications are listed below by basic designations only and are included in this Article to the extent referenced

1. American Society for Testing and Materials (ASTM):  
E84-2008.....Surface Burning Characteristics of Building  
Materials

2. National Fire Protection Association (NFPA):

- 10-2006.....Standard for Portable Fire Extinguishers
- 30-2007.....Flammable and Combustible Liquids Code
- 51B-2003.....Standard for Fire Prevention During Welding,  
Cutting and Other Hot Work
- 70-2007.....National Electrical Code
- 241-2004.....Standard for Safeguarding Construction,  
Alteration, and Demolition Operations

3. Occupational Safety and Health Administration (OSHA):

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

- B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, and submit to COTR/COTR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the general contractor's competent person per OSHA requirements. This briefing shall include information on the construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, etc. Documentation shall be provided to the COTR that individuals have undergone contractor's safety briefing.
- C. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with COTR/COTR.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily, and report findings and corrective actions weekly to COTR/COTR.
- H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.

- I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- J. 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 COTR/ COTR. 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 COTR.
- K. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with COTR/COTR.
- L. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COTR/COTR. Obtain permits from facility Safety Specialist in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- M. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COTR and facility Safety Specialist.
- N. 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.
- O. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- P. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

#### **1.7 OPERATIONS AND STORAGE AREAS**

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

temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

- C. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.
- D. Working space and space available for storing materials shall be as determined by the COTR.
- E. Workmen are subject to rules of the Medical Center applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of the 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 COTR where required by limited working space.
  - 1. Do not store materials and equipment in other than assigned areas.
  - 2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.
  - 3. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.
- G. 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.

- H. Construction Fence: Before construction operations begin, Contractor shall provide security/safety fencing around the perimeter of the work area. Fencing shall remain intact throughout construction and removed when directed by COTR.
- I. Utilities Services: Maintain existing utility services for the Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COTR.
  - 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 COTR.
  - 2. Contractor shall submit a request to interrupt any such services to COTR, 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 the 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 COTR.
  - 5. In case of a contract construction emergency, service will be interrupted on approval of COTR. Such approval will be confirmed in writing as soon as practical.
- J. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged.

- K. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:
  - 1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation crosses existing roads, at least one lane must be open to traffic at all times.
  - 2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COTR.
- L. Coordinate the work for this contract with other construction operations as directed by COTR. This includes the scheduling of traffic and the use of roadways.
- M. Phasing: The Contractor shall meet with the VA staff before starting any work to establish a firm phased schedule for the work. Once set, the Contractor must comply with the schedule unless unforeseen circumstances keep the Contractor from adhering to the schedule. During the scheduling meeting between the VAMC and the Contractor, actual dates shall be applied. Total construction period shall be a maximum of thirty (30) days.

#### **1.8 ALTERATIONS**

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COTR in areas of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both representatives, to the Contracting Officer. This report shall list by rooms and spaces:
  - 1. Shall note any discrepancies between drawings and existing conditions at site.
  - 2. Shall designate areas for working space, materials storage and access routes to areas within buildings where alterations occur and which have been agreed upon by Contractor and COTR.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COTR to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly.
- C. It is the Contractor's responsibility to restore any damage to building finishes, etc., caused by workmen during the execution of the contract.

1. A Re-survey report shall be prepared listing any damage caused by Contractor, despite protection measures; and will form a basis for determining the extent of repair work required of Contractor.

#### **1.9 DISPOSAL AND RETENTION**

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

- 40 CFR 261..... Identification and Listing of Hazardous Waste
- 40 CFR 262..... Standards Applicable to Generators of Hazardous Waste
- 40 CFR 263..... Standards Applicable to Transporters of Hazardous Waste
- 40 CFR 761..... PCB Manufacturing, Processing, Distribution in Commerce, and use Prohibitions
- 49 CFR 172..... Hazardous Material tables and Hazardous Material Communications Regulations
- 49 CFR 173..... Shippers - General Requirements for Shipments and Packaging
- 49 CFR 173..... Subpart A General
- 49 CFR 173..... Subpart B Preparation of Hazardous Material for Transportation
- 49 CFR 173..... Subpart J Other Regulated Material; Definitions and Preparation
- TSCA..... Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7

5. Recycle all locally recyclable materials. At the start of the project the General Contractor shall provide a written demolition debris management plan to the COTR. Contractor shall provide storage receptacles on site, or store offsite. At minimum recycle Metal Ductwork, Soil, Inerts (e.g., concrete, masonry and asphalt), Clean dimensional wood and palette wood, Green waste (biodegradable landscaping materials), Engineered wood products (plywood, particle board and I-joists, etc), Metal products (e.g., steel, wire, beverage containers, etc), Cardboard, paper and packaging, Bitumen roofing materials, Plastics (e.g., ABS, PVC), Carpet and/or pad, Gypsum board, Insulation, and Paint. Provide a waste manifest detailing where materials went. Submit a copy of the manifest to the COTR. 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.

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

- A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass), on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor

shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

- B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site. The Contractor shall repair any damage to those facilities, 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.

#### **1.11 RESTORATION**

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the COTR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COTR 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 (mechanical and electrical work, lawns, sprinklers, 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.

#### **1.12 LAYOUT OF WORK**

- A. The Contractor shall lay out the work as indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the COTR/Contracting Officer Technical Representative.

(FAR 52.236-17)

#### **1.13 USE OF ROAD WAYS**

- A. For hauling, use only established public roads and roads on Medical Center property and, when authorized by the COTR, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well constructed bridges.

#### **1.14 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 amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.

#### **1.15 RELOCATED EQUIPMENT/ITEMS**

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment shown to be relocated by the Contractor.
- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the COTR.
- C. Suitably cap existing service lines, such as steam, condensate return, water, drain, and/or electrical, whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".

- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.
- E. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

#### **1.16 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 COTR's review, as often as requested.
- C. Contractor shall deliver two approved completed sets of as-built drawings to the COTR within 15 calendar days after each completed phase and after the acceptance of the project by the COTR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

#### **1.17 INSTRUCTIONS**

- A. Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals (four copies each) for each separate piece of equipment shall be delivered to the COTR 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. Use environmentally friendly, "Green", products where applicable. Such as Energy star rated, low VOC, recycled material, etc.

#### **1.18 HISTORIC PRESERVATION**

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

#### **1.19 RECYCLING MATERIAL**

- A. Recycle all locally recyclable materials. At start of project provide a written demolition debris management plan to COTR.
  - 1. Contractor shall provide storage receptacles on site, or store offsite. At minimum recycle Soil, Inerts (eg, concrete, masonry and asphalt), Clean dimensional wood and palette wood, Green waste (biodegradable landscaping materials), Engineered wood products (plywood, particle board and I-joists, etc), Metal products (eg, steel, wire, beverage containers, etc), Cardboard, paper and packaging, Bitumen roofing materials, Plastics (eg, ABS, PVC), Carpet and/or pad, Gypsum board, Insulation, and Paint.
  - 2. Submit to the COTR a debris diversion and disposal manifest listing amounts/volumes and the final destination of all recycled material. With each application for progress payment, submit a summary of construction and demolition debris disposal including beginning and ending dates of period covered.

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

- 1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in Section 00 72 00, GENERAL CONDITIONS.
- 1-2. For the purposes of this contract, test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1-3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
  - A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
  - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
  - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1-4. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals will not serve as a basis for extending contract time for completion.
- 1-5. Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by COTR on behalf of the Contracting Officer.
- 1-6. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.
- 1-7. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price

and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.

- 1-8. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect-Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- 1-9. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
  - A. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
  - B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail and shall contain the list of items, name of Medical Center, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
    1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.
    2. Manufacturers' literature and data shall be labeled to indicate the name and location of the Medical Center, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
    3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.
- 1-10. Shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

West Plains Engineering

(Architect-Engineer)

1750 Rand Road

(A/E P.O. Address)

Rapid City, South Dakota 57702

(City, State and Zip Code)

- 1-11. At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the COTR.

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

**EP-1. DESCRIPTION**

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

7. Sanitary Wastes:

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

**EP-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.

**EP-3. REFERENCES**

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

**EP-4. SUBMITTALS**

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

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

**EP-5. PROTECTION OF ENVIRONMENTAL RESOURCES**

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

- isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.
2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
    - a. Box and protect from damage existing trees and shrubs to remain on the construction site.
    - b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
    - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
  3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
  4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.
  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 COTR.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
- D. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Wyoming.
1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
  2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
  3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
  4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- E. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as

directed by the COTR. 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 5:00 p.m unless otherwise permitted by local ordinance or the COTR. 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

- F. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.
- G. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the COTR. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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

**1.1 DESCRIPTION**

This specification covers the requirements for management of non-hazardous building construction and demolition waste.

**1.2 RELATED WORK**

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 11, EARTH MOVING (SHORT FORM).
- B. Safety Requirements: GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Reserved items which are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.

**1.3 GOVERNMENT POLICY**

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building construction products.
- B. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators and facilitate their recycling.
- C. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling and any revenues or savings obtained from salvage or recycling shall accrue to the Contractor.
- D. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by federal, state and local regulations.

**1.4 PLAN**

- A. Conduct a site assessment to estimate the types of materials that will be generated by demolition at the site.
- B. Develop and implement procedures to reuse and recycle materials to the greatest extent feasible based upon the contract, the construction and demolition debris management plan, the estimated quantities of materials, and the availability of recycling facilities.

**1.5 COLLECTION**

- A. Provide necessary containers, bins and storage areas to facilitate effective waste management.
- B. Clearly identify so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.

**1.6 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 law.
- B. Building or demolition materials with no practical use or that cannot be recycled shall be disposed of at a landfill or incinerator.

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**SECTION 07 11 13  
BITUMINOUS DAMPPROOFING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies materials and workmanship for bituminous dampproofing on concrete and masonry surfaces.

**1.2 SUBMITTALS:**

A. Manufacturer's Literature and Data:

1. Product description.
2. Application instructions.

**1.3 APPLICABLE PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- D226-06.....Asphalt-Saturated Organic Felt Used in Roofing  
and Waterproofing
- D1227-95 (R2007).....Emulsified Asphalt Used as a Protective Coating  
for Roofing

**PART 2 - PRODUCTS**

**2.1 EMULSIFIED ASPHALT:**

ASTM D1227, Type III, class 1.

**2.2 ASPHALT SATURATED FELT:**

ASTM D226, Type I, 7 kg (15 pound).

**PART 3 - EXECUTION**

**3.1 SURFACE PREPARATION:**

- A. Surfaces to receive dampproofing shall be clean and smooth.
- B. Remove foreign matter, loose particles of mortar or other cementitious droppings.
- C. Clean and wash soil or dirt particles from surface.
- D. Remove free water; surfaces may be damp.
- E. Surfaces shall be approved by COTR before dampproofing is applied.

**3.2 APPLICATION:**

- A. Schedule application so that drying will be accomplished prior to backfilling and so that backfilling will be accomplished as soon as possible after drying.

- B. Apply when the ambient temperature is above 4°C (40°F) and rising. Do not apply if the temperature is expected to fall below 4°C (40°F).
- C. Apply in accordance with manufacturer's printed instructions unless specified otherwise.
- D. Apply each coat at the rate of not less than 1 L/m<sup>2</sup> (2-1/2 gallons per 100 square feet) and allow not less than 24 hours drying time after application.
- E. Apply first coat by brush, spray, or mop and allow to dry.
- F. Apply second coat by brush or mop and allow to dry.
- G. Inspect for holidays; recoat holidays. The finish dampproofing shall be free of holidays.

### **3.3 PROTECTIVE COVERING:**

- A. Protect dampproofing surfaces against which backfill will be placed with one layer of 7 kg (15 pound) asphalt saturated felt.
- B. Imbed felt shingle fashion in the second coating of bitumen.
- C. Lap edges and ends of felt not less than 25 mm (1 inch), coating laps with emulsion.

### **3.4 LOCATION:**

- A. Dampproof exterior surfaces below grade.
- B. Apply to other surfaces where shown.

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**SECTION 23 05 11**  
**COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

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

**1.2 RELATED WORK**

- A. Section 00 72 00, GENERAL CONDITIONS.
- B. Section 01 00 00, GENERAL REQUIREMENTS.
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Excavation and Backfill: Section 31 20 11, EARTH MOVING.
- E. Concrete and Grout: Section 32 05 23, CAST-IN-PLACE CONCRETE.
- F. Section 33 63 00, STEAM ENERGY DISTRIBUTION.

**1.3 QUALITY ASSURANCE**

- A. Products Criteria:
  - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. See other specification sections for any exceptions.
  - 2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
  - 3. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
  - 4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
  - 5. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
  - 6. Asbestos products or equipment or materials containing asbestos shall not be used.

- B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
  2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
  3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
- C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COTR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

#### **1.4 SUBMITTALS**

- A. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
1. Equipment and materials identification.
- B. 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.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning and Refrigeration Institute (ARI):
- 430-99.....Central Station Air-Handling Units
- C. American National Standard Institute (ANSI):
- B31.1-2001.....Power Piping
- D. Rubber Manufacturers Association (ANSI/RMA):
- IP-20-2001.....Drives Using Classical V-Belts and Sheaves
- IP-21-88.....Drives Using Double-V (Hexagonal) Belts
- IP-22-91.....Drives Using Narrow V-Belts and Sheaves

- E. Air Movement and Control Association (AMCA):
  - 410-96.....Recommended Safety Practices for Air Moving Devices
- F. American Society of Mechanical Engineers (ASME):
  - Boiler and Pressure Vessel Code (BPVC):
  - SEC IX-98.....Qualifications Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators
  - Section I.....Power Boilers
  - Code for Pressure Piping:
    - B31.1-04.....Power Piping, with Amendments
- G. American Society for Testing and Materials (ASTM):
  - A36/A36M-2001.....Carbon Structural Steel
  - A575-96.....Steel Bars, Carbon, Merchant Quality, M-Grades R (2002)
  - E84-2003.....Standard Test Method for Burning Characteristics of Building Materials
  - E119-2000.....Standard Test Method for Fire Tests of Building Construction and Materials
- H. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
  - SP-58-93.....Pipe Hangers and Supports-Materials, Design and Manufacture
  - SP 69-2003.....Pipe Hangers and Supports-Selection and Application
- J. National Electrical Manufacturers Association (NEMA):
  - MG1-2003, Rev. 1-2004...Motors and Generators
- K. National Fire Protection Association (NFPA):
  - 31-06.....Standard for Installation of Oil-Burning Equipment
  - 54-06.....National Fuel Gas Code
  - 70-05.....National Electrical Code
  - 85-04.....Boiler and Combustion Systems Hazard Code
  - 90A-96.....Installation of Air Conditioning and Ventilating Systems
  - 101-97.....Life Safety Code

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

- A. Protection of Equipment:
  - 1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and

material. The Contractor is solely responsible for the protection of such equipment and material against any damage.

2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the RE/COTR. Such repair or replacement shall be at no additional cost to the Government.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

## **PART 2 - PRODUCTS**

### **2.1 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

- A. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- B. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
  1. General Types (MSS SP-58):
    - a. Standard clevis hanger: Type 1; provide locknut.
    - b. Riser clamps: Type 8.
    - c. Wall brackets: Types 31, 32 or 33.
    - d. Roller supports: Type 41, 43, 44 and 46.
    - e. Saddle support: Type 36, 37 or 38.
    - f. Turnbuckle: Types 13 or 15. preinsulate
    - g. U-bolt clamp: Type 24.

#### h. Copper Tube:

- 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non adhesive isolation tape to prevent electrolysis.
- 2) For vertical runs use epoxy painted or plastic coated riser clamps.
- 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
- 4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.

#### C. 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.

## 2.2 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. Follow manufacturer's published recommendations for installation methods not otherwise specified.

- B. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- C. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- D. Cutting Holes:
  - 1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by RE/COTR where working area space is limited.
  - 2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by RE/COTR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to RE/COTR for approval.
  - 3. Do not penetrate membrane waterproofing.
- E. 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 COTR. Damaged or defective items in the opinion of the COTR, shall be replaced.
- F. Work in Existing Building:
  - 1. Make alterations to existing service piping at times that will least interfere with normal operation of the facility.
  - 2. 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 COTR. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the COTR for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After COTR's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.

### **3.2 PIPE AND EQUIPMENT SUPPORTS**

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the COTR.

- B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.
- C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work.
- D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69. Provide a support within one foot of each elbow.

### **3.3 HVAC DEMOLITION**

- A. Completely remove all piping, wiring, conduit, and other devices associated with the equipment not to be re-used in the new work. This includes all pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. Seal all openings, after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- B. All valves including gate, globe, ball, butterfly and check shall remain Government property and shall be removed and delivered to RE/COTR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

### **3.4 OPERATING AND PERFORMANCE TESTS**

- A. 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.

### **3.5 INSTRUCTIONS TO VA PERSONNEL**

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

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**SECTION 23 22 13**  
**STEAM AND CONDENSATE HEATING PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. 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. Excavation and backfill: Section 31 20 11, EARTH MOVING.
- B. Underground steam and condensate distribution: Section 33 63 00, STEAM ENERGY DISTRIBUTION.
- 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.

**1.3 QUALITY ASSURANCE**

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

**1.4 SUBMITTALS**

- A. Manufacturer's Literature and Data:
  - 1. Pipe and equipment supports.
  - 2. Pipe and tubing, with specification, class or type, and schedule.
  - 3. Pipe fittings, including miscellaneous adapters and special fittings.
  - 4. Flanges, gaskets and bolting.
  - 5. Valves of all types.
  - 6. Strainers.
  - 7. Pipe alignment guides.
  - 8. All specified steam system components.
- B. Manufacturer's certified data report, Form No. U-1, for ASME pressure vessels:
  - 1. Flash tanks.

**1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Institute Standard (ANSI):
  - B1.20.1-01.....Pipe Threads, General Purpose (Inch)
- C. American Society of Mechanical Engineers (ASME):
  - B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings
  - B16.3-98.....Malleable Iron Threaded Fittings

- B16.4-98.....Gray Iron Threaded Fittings  
 B16.9-01.....Factory-Made Wrought Buttwelding Fittings  
 B16.11-02.....Forged Fittings, Socket-Welding and Threaded  
 B16.14-91.....Ferrous Pipe Plugs, Bushings, and Locknuts with  
                     Pipe Threads  
 B16.22-98.....Wrought Copper and Copper Alloy Solder-Joint  
                     Pressure Fittings  
 B16.23-92.....Cast Copper Alloy Solder Joint Drainage Fittings  
 B16.24-01.....Cast Copper Alloy Pipe Flanges and Flanged  
                     Fittings, Class 150, 300, 400, 600, 900, 1500  
                     and 2500  
 B16.39-98.....Malleable Iron Threaded Pipe Unions, Classes  
                     150, 250, and 300  
 B31.1-01.....Power Piping  
 B31.9-96.....Building Services Piping  
 B40.100-98.....Pressure Gauges and Gauge Attachments  
 Boiler and Pressure Vessel Code: SEC VIII D1-2001, Pressure Vessels,  
 Division 1  
 D. American Society for Testing and Materials (ASTM):  
 A47-99.....Ferritic Malleable Iron Castings  
 A53-01.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated,  
                     Welded and Seamless  
 A106-99.....Seamless Carbon Steel Pipe for High-Temperature  
                     Service  
 A126-01.....Standard Specification for Gray Iron Castings  
                     for Valves, Flanges, and Pipe Fittings  
 A181-01.....Carbon Steel Forgings, for General-Purpose  
                     Piping  
 A183-98 ..... Carbon Steel Track Bolts and Nuts  
 A216-98 ..... 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  
 A307-00 ..... Carbon Steel Bolts and Studs, 60,000 PSI Tensile  
                     Strength  
 A516-01 ..... Pressure Vessel Plates, Carbon Steel, for  
                     Moderate-and- Lower Temperature Service  
 A536-99 ..... Standard Specification for Ductile Iron Castings  
 B32-00 ..... Solder Metal  
 B61-93 ..... Steam or Valve Bronze Castings

- B62-93 ..... Composition Bronze or Ounce Metal Castings
- B88-99 ..... Seamless Copper Water Tube
- F439-01 ..... Socket-Type Chlorinated Poly (Vinyl Chloride)  
(CPVC) Plastic Pipe Fittings, Schedule 80
- F441-99 ..... Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic  
Pipe, Schedules 40 and 80
- E. American Welding Society (AWS):
  - A5.8-92.....Filler Metals for Brazing and Braze Welding
  - B2.1-00.....Welding Procedure and Performance Qualifications
- F. Manufacturers Standardization Society (MSS) of the Valve and Fitting  
Industry, Inc.:
  - SP-67-95.....Butterfly Valves
  - SP-70-98.....Cast Iron Gate Valves, Flanged and Threaded Ends
  - SP-71-97.....Gray Iron Swing Check Valves, Flanged and  
Threaded Ends
  - SP-72-99.....Ball Valves with Flanged or Butt-Welding Ends  
for General Service
  - SP-78-98.....Cast Iron Plug 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
- G. Military Specifications (Mil. Spec.):
  - MIL-S-901D-1989.....Shock Tests, H.I. (High Impact) Shipboard  
Machinery, Equipment, and Systems
- H. National Board of Boiler and Pressure Vessel Inspectors (NB): Relieving  
Capacities of Safety Valves and Relief Valves
- I. Tubular Exchanger Manufacturers Association: TEMA 18th Edition, 2000

## **PART 2 - PRODUCTS**

### **2.1 PIPE AND EQUIPMENT SUPPORTS**

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; A106 Grade B,  
Seamless; Schedule 40.
- B. Steam Condensate Piping:
  - 1. Concealed above ceiling, in wall or chase: Copper water tube ASTM  
B88, Type K, hard drawn.
  - 2. All other locations: Copper water tube ASTM B88, Type K, hard drawn;  
or steel, ASTM A53, Grade B, Seamless or ERW, or A106 Grade B  
Seamless, Schedule 80.

### 2.3 FITTINGS FOR STEEL PIPE

- A. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints. Mechanical couplings and fittings are optional for water piping only.
  - 1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
  - 2. Welding flanges and bolting: ASME B16.5:
    - a. 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 degrees F and 1500 psi.
    - c. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- B. 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 are 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. Unions: ASME B16.39.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and thredolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gage connections.

### 2.4 FITTINGS FOR COPPER TUBING

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

### 2.5 DIELECTRIC FITTINGS

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- C. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.

- D. Temperature Rating, 121 degrees C (250 degrees F) for steam condensate and as required for steam service.

## 2.6 SCREWED JOINTS

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

## 2.7 VALVES

- A. Asbestos packing is not acceptable.
- B. All valves of the same type shall be products of a single manufacturer. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.
- C. Gate Valves:
  - 1. 50 mm (2 inches) and smaller: MSS-SP80, Bronze, 1034 kPa (150 lb.), wedge disc, rising stem, union bonnet.
  - 2. 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke.
    - a. 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 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel solid disc and seats. Provide 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.
- D. Swing Check Valves:
  - 1. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.).
  - 2. 65 mm (2 1/2 inches) and larger:
    - a. All services: MSS-SP-71 for check valves.

## 2.8 STRAINERS

- A. Basket or Y Type.
- B. High Pressure Steam: Rated 1034 kPa (150 psig) saturated steam.
  - 1. 65 mm (2-1/2 inches) and larger: Flanged cast steel or 1723 kPa (250 psig) cast iron.
  - 2. 50 mm (2 inches) and smaller: Iron, ASTM A116 Grade B, or bronze, ASTM B-62 body with screwed connections (250 psig).
- C. All Other Services: Rated 861 kPa (125 psig) saturated steam.
  - 1. 65 mm (2-1/2 inches) and larger: Flanged, iron body.
  - 2. 50 mm (2 inches) and smaller: Cast iron or bronze.
- D. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows:
  - 1. 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 STEAM SYSTEM COMPONENTS

- A. 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 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.
- B. Steam Trap: Each type of trap shall be the product of a single manufacturer. **Traps shall be manufactured by Spirax-Sarco, Armstrong.** Provide trap sets at all low points and at 61 m (200 feet) intervals on the horizontal main lines.
  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 rated for the pressure upstream of the PRV supplying the system.
  3. Balanced pressure thermostatic elements: Phosphor bronze, stainless steel or monel metal.
  4. Valves and seats: Suitable hardened corrosion resistant alloy.
  5. Mechanism: Brass, stainless steel or corrosion resistant alloy.
  6. Floats: Stainless steel.
  7. Inverted bucket traps: Provide bi-metallic thermostatic element for rapid release of non-condensables.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to

connect pipes to equipment. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the government. 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.
- 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.
- F. Where copper piping is connected to steel piping, provide dielectric connections.

### **3.2 PIPE JOINTS**

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. 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 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.

**3.4 LEAK TESTING**

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COTR. Tests may be either of those below, or a combination, as approved by the COTR.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure.

**3.5 FLUSHING AND CLEANING PIPING SYSTEMS**

- A. 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.

**3.6 OPERATING AND PERFORMANCE TEST AND INSTRUCTION**

- A. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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**SECTION 26 42 00  
CATHODIC PROTECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies complete galvanic anode type cathodic protection systems for outside steam distribution systems. The section also includes devices to electrically isolate the system being protected.

**1.2 RELATED WORK**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Coating on underground steel casings for steam distribution systems:  
Section 33 63 00, STEAM ENERGY DISTRIBUTION

**1.3 QUALITY ASSURANCE**

The Contractor shall be regularly engaged in the installation and testing of cathodic protection systems. Contractor's personnel shall be experienced and shall be supervised by an engineer who is accredited as a Corrosion Specialist by NACE International (organization of corrosion engineers). All calculations, design and testing shall be performed by or supervised by the Corrosion Specialist. All procedures shall conform to recommendations of NACE RP0169 unless specified otherwise.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Furnish catalog cuts and shop drawings of following items:
  - 1. Anodes.
  - 2. Cable and wire.
  - 3. Test stations.
  - 4. Terminal boxes.
  - 5. Isolating flanges, unions, coatings, casing seals.
  - 6. Exothermic welding devices.
  - 7. Cable splice kits.
  - 8. Layout drawings, wiring diagrams.
  - 9. Test instruments.
  - 10. Dielectric tape.
  - 11. Test connection points.
- C. Accreditation of Corrosion Specialists by NACE International.
- D. Calculations, from field survey, performed by Corrosion Specialist.

**1.5 APPLICABLE PUBLICATIONS**

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

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

B8-04.....Concentric-Lay-Stranded Copper Conductors, Hard,  
Medium Hard, or Soft

D1248-04.....Polyethylene Plastic Extrusion Materials for  
Wire and Cable

G57-95a (2001).....Field Measurement of Soil Resistivity Using the  
Wenner Four-Electrode Method

## C. American Society of Mechanical Engineers (ASME):

B16.5-03.....Pipe Flanges and Flanged Fittings: NPS ½ through  
24

## D. NACE International (The Corrosion Society)(NACE):

RP0169-02.....Control of External Corrosion on Underground or  
Submerged Metallic Piping Systems

**PART 2 - PRODUCTS****2.1 ANODES**

A. Type: Magnesium, factory-packed in cloth bag or box containing prepared backfill mixture, with lead wires.

## B. Construction:

## 1. Alloy Specifications:

Element	Percent-(Option-1)	Percent-(Option-2)
Aluminum	5.0 - 7.0	0.010 Max.
Manganese	0.15 Min.	0.50 - 1.30
Zinc	2.0 - 4.0	0.05 Max.
Silicon	0.30 Max.	0.05 Max.
Copper	0.10 Max.	0.02 Max.
Nickel	0.003 Max.	0.001 Max.
Iron	0.003 Max.	0.03 Max.
Other	0.30 Max.	0.30 Max.
Magnesium	Remainder	Remainder

2. Core: Perforated galvanized steel, maximum 0.148 kg per meter (0.10-pounds per linear foot), one end accessible in a recess for lead wire connection.

3. Lead Wire: Number 12 solid copper, 3000 mm (10 feet) long, high molecular weight polyethylene insulation, ASTM D1248, Type 1, Class C, Category 5, Grade E5.

4. Lead Wire Attachment to Core: Silver-solder. Fill anode recess with electrical potting compound.

5. Packaging: Permeable cloth bag or box with backfill mixture completely surrounding anode 15 mm (1/2 inch) minimum.
- a. Grain Size: Pass through 20-mesh screen -- 100 percent; retained by 100-mesh screen -- 50 percent.
  - b. Components:

Ground Hydrated Gypsum	75 percent
Powdered Wyoming Bentonite	20 percent
Anhydrous Sodium Sulphate	5 percent

- c. Weight: Weight requirements are listed on the drawings. Listings refer to alloy weight only.

## 2.2 INSULATED CABLE

- A. Type: One conductor, stranded, annealed copper, high molecular weight polyethylene insulation and jacket.
- B. Service: Buried in corrosive soils. Header cable, test leads, bonding cable.
- C. Construction:
  1. Table:

MINIMUM THICKNESS OF INSULATION AND JACKET		
AWG-SIZE	NUMBER-OF-STRANDS	mm (inches)
No. 8	7	2.8 (7/64)
No. 6	7	2.8 (7/64)
No. 4	7	2.8 (7/64)
No. 2	7	2.8 (7/64)
No. 1	19	3.2 (8/64)
No. 1/10	19	3.2 (8/64)

2. Insulation: ASTM D1248, Type 1, Class C, Category 5, Grade E5.
3. Conductors: ASTM B8.

## 2.3 CABLE CONNECTIONS

- A. Type: Connections between cables and pipes, casings or structures shall be exothermic fusion-welding process using copper oxide, aluminum and vanadium welding material in graphite molds. Connections between cables and between cables and leads shall be corrosion-resistant split bolts.
- B. Insulation of Cable-to-Cable Connections: Epoxy-resin splice kits with two-part resin, mold, sealing mastic.

- C. Coating of Cable Connections to Protected Structures: Field-applied coating similar to that on the protected structure.

## **2.4 TEST STATIONS**

- A. Type: Weatherproof, located at grade, or aboveground if so shown.  
Enclosed terminals for anode leads, test leads, and leads attached to protected system. Connection points for test instruments.
- B. Construction:
  1. Housing: High-impact resistant plastic. Provide means to anchor housing below grade. Locking cover for terminal board. Yellow color.
  2. Terminal Board: High-impact resistant plastic board, cadmium or zinc-plated hardware, accessible from front and rear, sufficient terminals for all required connections.

## **2.5 DIELECTRIC TAPE**

Vinyl plastic electrical tape, 0.18 to 0.25 mm (7 - 10 mils) thick, pressure-sensitive adhesive.

## **2.6 WARNING TAPE**

50 mm (2 inches) wide, detectable with metal detector, mylar-encased aluminum, orange color, imprinted "Cathodic Protection Cable Below".

## **2.7 DIELECTRIC INSULATION**

- A. Types: Insulating gaskets, sleeves and washers for pipe flanges, insulating unions for threaded pipe, casing seals between pipes or conduits and wall sleeves, dielectric coatings for systems contacting concrete.
- B. Service: Steam, condensate and oil piping systems as shown.
- C. Flange Applications:
  1. Gaskets and Sleeves and Washers for Bolting: Steam service, rated for 193 °C (360 °F); steam condensate service rated for 100 °C (212 °F); oil service, oil-resistant rated for 66 °C (150 °F). Provide steel back-up washers on insulated washers.
  2. Flanges: Conform to ASME B16.5, 1025 kPa (150 psi) weld neck.
- D. Union Applications: Minimum 1200 kPa (175 psi), designed for service at the temperature of the fluid in the pipe, designed for type of fluid.
- E. Wall Penetration: Rated for dielectric service, 66 °C (150 °F) for oil service, 121 °C (250 °F) for steam service, 100 °C (212 °F) for steam condensate service, tight water and air seal at 3 m (ten feet) of water head, factory-built device consisting of EPDM or silicone rubber segments linked together. Acceptable manufacturers: Metraflex Metraseal, Thunderline Link-Seal.
- F. Coatings: Designed for cold application, service temperature of carrier pipe, high electrical resistivity.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Anodes: Install in native soil, 900 mm (3 feet) minimum from protected structure, below centerline of protected structure, and at locations shown. Backfill shall be native soil.
- B. Cables and Anode Leads:
  - 1. Burial: 600 mm (2 feet) minimum below finished grade, 150 mm (6 inch) minimum separation from other underground structures, backfill material in contact with cable free of rocks and debris.
  - 2. Continuity Bonds: Use cable to connect adjacent protected structures, and protected structures separated by non-welded connectors. Provide 25 percent additional length as slack to allow differential movement of protected systems.
  - 3. Connections: Provide clean, bright, bare metal surface at all connection points.
  - 4. Warning Tape: Install 150 mm (6 inches) below grade, directly above cables.
- C. Test Stations: Install where shown or as directed by COTR (RE)/Contracting Officers Technical Representative (COTR), anchor firmly, terminal board 600 mm (2 feet) minimum above grade for above grade units. Connect all anodes and protected structure to the test stations.
- D. Dielectric Insulation:
  - 1. General: Provide complete dielectric insulation between protected and unprotected systems and between protected systems and structures which could ground the cathodic protection. Required insulation points include all pipe entrances to buildings, manholes, and pits.
  - 2. Flanges: Install in locations open to view after completion of construction. Provide insulating gaskets, insulating sleeves on all bolts, insulating washers under bolt heads and nuts.
  - 3. Unions: Install in locations open to view after completion of construction. Unions not permitted in pipe sizes over 50 mm (2 inches).
  - 4. Wall Penetration Seals: Install in space between pipes and wall sleeves at building and manhole walls.
  - 5. Coatings: Completely coat all pipe or conduit areas that are in contact with concrete.

**3.2 FIELD QUALITY CONTROL**

- A. Provide system with a calculated design life exceeding 40 years.
- B. Pre-construction Survey: The Corrosion Specialist shall perform a soil resistivity survey using the Wenner Four-Pin Method as described in ASTM

G57. Survey entire length of proposed protected system at the structure depth. Also survey native-state structure-to-soil potential, soil pH, and presence of stray currents.

- C. Calculations: The Corrosion Specialist shall perform engineering calculations to verify the design of the system shown. The calculations shall follow a format published by a recognized corrosion expert. Inform the Government of any recommended changes in the system design shown.
- D. Field Inspections During Construction: The corrosion specialist shall inspect the work at least twice to ascertain that there is no grounding, short circuits, coating damage, and that installation is in accordance with requirements.
- E. Final Inspection:
  - 1. Performed by Corrosion Specialist; witnessed by RE/COTR.
  - 2. Test Instruments:
    - a. Digital Volt-Ammeter with impedance of 7-10 mega-ohms/volt.
    - b. Saturated copper-copper sulfate reference electrode.
    - c. Other instruments as required.
  - 3. Procedures: Conform to NACE RP0169.
  - 4. Test Results Required for Acceptance:
    - a. Potential of minus 0.85 volt between protected structure and reference electrode.
    - b. Minimum shift of minus 300 millivolts upon application of protective current. Voltage measured between protected structure and reference electrode.
    - c. Minimum shift of minus 100 millivolts upon interruption of protective current. Voltage measured between protected structure and reference electrode.
    - d. Amperage value sufficient that anode life 40 years can be calculated. Provide calculations.
  - 5. Test Report: Provide, to RE/COTR, complete report showing all test measurements, calculations, list of instruments used.

### 3.3 AS-BUILT DRAWINGS

Provide one set of reproducible drawings showing dimensioned locations of all anodes, cables, test stations, and also anode weights. Provide identification of test stations and anodes keyed to test reports.

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**SECTION 31 20 11  
EARTH MOVING (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, hydro-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.

B. Earthwork: Earthwork operations 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 ASTM.

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

**1.3 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.

**1.4 APPLICABLE PUBLICATIONS:**

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

B. American Association of State Highway and Transportation Officials (AASHTO):

T99-01.....Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop

T180-01.....Moisture-Density Relations of Soils Using a  
4.54-kg [10 lb] Rammer and a 457 mm (18 inch)  
Drop

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

D698-00.....Laboratory Compaction Characteristics of Soil  
Using Standard Effort

D1557-02.....Laboratory Compaction Characteristics of Soil  
Using Modified Effort

D. Standard Specifications of (Insert name of local state) 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/m<sup>3</sup> (110 pcf), a maximum Plasticity Index of 6, and a maximum Liquid Limit of 30.
- B. Granular Fill:
  - 1. Under concrete slab, crushed stone or gravel graded from 25 mm (1 inch) to 4.75 mm (No. 4).
- 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. Hydro-Seed:
  - 1. Delivery, Storage, and Handling:
    - a. Seed:
      - 1) Delivery: Furnish standard seed in unopened manufacturer's standard containers bearing original certification labels showing quantity, analysis and name of manufacturer.
      - 2) Storage: Protect seed from weather or other conditions that would damage or impair the effectiveness of the product.
    - b. Mulch:
      - 1) Labeling: Each package of cellulose fiber shall be marked by the manufacturer to show the air dry weight content.
      - 2) Storage: Protect from weather or other conditions that would damage or impair the effectiveness of the product.
  - 2. Timing of Installation:
    - a. Begin hydroseeding during cooler part of the year.

- b. Irrigated Areas: Within fourteen (14) calendar days after the completion and acceptance of finish grading in any area.
  - c. Unirrigated Areas: Between August 15 and December 1 of any calendar year.
- 3. Warranty:
  - a. Time Period: Warrant that grasses shall be in a healthy and flourishing condition of active growth of six (6) months from date of Final Acceptance.
  - b. Appearance During Warranty: Grasses shall be free of dead or dying patches, and all areas shall show foliage of a normal density, size and color.
  - c. Delays: Delays caused by the Contractor in completing planting operations which extend the planting into more than one planting season shall extend the Warranty Period correspondingly.
  - d. Coverage: Warrant growth and coverage of hydroseeded planting to the effect that a minimum of 95% of the area planted shall be covered with specified planting after one growing season with no bare spots.
- 4. Seed:
  - a. Composition: Fresh, clean, certified, new crop seed of the following varieties mixed in the following proportions:
    - 45% Blue Grass
    - 40% Fescue
    - 15% Rye
 Mixture shall be approved by COTR.
- 5. Accessories:
  - a. Water: Potable water as furnished by Owner. Transport as required.
  - b. Mulch:
    - 1. Composition: Green-colored, fibrous, 100% virgin wood fiber mulch containing no growth or germination-inhibiting factors.
    - 2. Weight: Weight specification refers only to air dry weight of the fiber material. Absolute air dry weight is considered equivalent to 10% moisture.
    - 3. Dispersion in Slurry: Mulch shall be manufactured in such manner that after addition to and agitation in slurry tanks with fertilizer, seed, water and other approved additives, fibers in the material will become uniformly suspended to form a homogeneous slurry.

4. Absorption Capacity: When hydraulically sprayed on the ground, the material will form a blotter-like groundcover impregnated uniformly with seed, which will allow the absorption of moisture and allow rainfall to percolate to the underlying soil.
- 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 1 1/4 inches) excluding top growth. There shall be no broken pads and torn or uneven ends.

### **PART 3 - EXECUTION**

#### **3.1 SITE PREPARATION:**

- A. Clearing: Clearing within the limits of earthwork operations as described or designated by the COTR. Work includes removal of trees, shrubs, fences, incidental structures, paving, debris, trash and any other obstructions. Remove materials from the Medical Center.
- B. 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 COTR. 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.
- C. 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 or shown on the drawings. 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 COTR. Eliminate foreign material, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials, larger than 0.014 m<sup>3</sup> (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on 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.

- D. 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.
- 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 COTR. Replace disturbed subgrade in trenches by mechanically tamped sand or gravel.
- C. Blasting: Blasting shall not be permitted.
- D. Trench Earthwork:
  1. Utility trenches:
    - 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. Support piping on undisturbed earth unless a mechanical support is shown.
- d. The length of open trench in advance of pipe laying shall not be greater than is authorized by the COTR.
- E. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials, that are determined by the COTR as unsuitable, and replace with acceptable material.
- F. 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 or indicated on the drawings.

### **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 pipes coming in contact with backfill have been installed, and inspected and approved by COTR.
- B. Proof-rolling Existing Subgrade: Proof-roll with a fully loaded dump truck. Make a minimum of one pass in each direction. Remove unstable uncompactable material and replace with granular fill material completed to mix requirements specified.
- C. 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.
- D. 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 COTR. 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 in accordance with the ASTM.

### **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. 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.
- C. Finish subgrade in a condition acceptable to the COTR 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.
- D. 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 COTR before hydro-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. **Contractor shall provide all necessary topsoil.**
- C. Fertilizing: Incorporate fertilizer into the soil to a depth of 100 mm (4 inches) at a rate of 12 kg/100 m<sup>2</sup> (25 pounds per 1000 square feet).
- D. Hydro-seed:
  - 1. Preparation: Do all slurry preparation at the job site. Do not allow seed to remain more than 30 min. in slurry.
  - 2. Application:
    - a. General: Apply specified slurry mix in a sweeping motion to form a uniform mat at the specified rate. Keep hydroseeding within designated areas and keep from contact with other plant materials.

- b. Unused Mix: Do not use slurry mixture that has not been applied within four (4) hours of mixing. Promptly remove from the site.
  - c. Protection: After application, do not operate any equipment over the hydro-seeded areas.
  - d. Reseeding: Reseed all areas and parts of areas that fail to show a uniform stand until all areas comply with Warranty above.
- 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 COTR 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. Contractor shall be responsible for seeding or sod for 28 days 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 COTR 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.

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**SECTION 32 05 23**  
**CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY:**

- A. This Section specifies cast-in-place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.
- B. Cast-in-place concrete includes the following:
  - 1. Sidewalks, walkways, steps, curb and gutter.

**1.3 SUBMITTALS:**

- A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for proprietary materials and items, including forming accessories, admixtures, patching compounds, curing compounds, and others if requested by Engineer.
- C. Samples of materials are requested by Engineer, including names, sources, and descriptions, as follow:
  - 1. Fiber reinforcement.
- D. Laboratory test reports for concrete materials and mix design test.

**1.4 QUALITY ASSURANCE:**

- A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified.
  - 1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings.
- B. Concrete Testing Service: Engage a testing agency acceptable to Engineer to perform material evaluation tests and to design concrete mixes.
- C. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Contractor's expense.

**PART 2 - PRODUCTS**

**2.1 FORM MATERIALS:**

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable

sizes to minimize number of joints and to conform to joint system shown on drawings.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form", Class I.
2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

## 2.2 CONCRETE MATERIALS:

A. Portland Cement: ASTM C 150, Type II modified (less than 3% C<sub>3</sub>A).

1. Use one brand of cement throughout Project unless otherwise acceptable to Engineer.

B. Fly Ash: ASTM C 618, Type F.

C. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.

1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.

D. Water: Potable.

E. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Air-Tie, Cormix Construction Chemicals.
  - b. Air-Mix or Perma-Air, Euclid Chemical Co.
  - c. Darex AEA or Daravair, W.R. Grace & Co.
  - d. MB-VR or Micro-Air, Master Builders, Inc.
  - e. Sealtight AEA, W.R. Meadows, Inc.
  - f. Sika AER, Sika Corp.

G. Water-Reducing Admixture: ASTM C 494, Type A.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Chemtard, ChemMasters Corp.
  - b. PSI N, Cormix Construction Chemicals.
  - c. Eucon WR-75, Euclid Chemical Co.
  - d. WRDA, W.R. Grace & Co.

- e. Pozzolith Normal or Polyheed, Master Builders, Inc.
  - f. Metco W.R., Metalcrete Industries.
  - g. Prokrete-N, Prokrete Industries.
  - h. Plastocrete 161, Sika Corp.
- H. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Super P, Anti-Hydro Co., Inc.
    - b. Cormix 200, Cormix Construction Chemicals.
    - c. Eucon 37, Euclid Chemical Co.
    - d. WRDA 19 or Daracem, W.R. Grace & Co.
    - e. Rheobuild or Polyheed, Master Builders, Inc.
    - f. Superslump, Metalcrete Industries.
    - g. PSPL, Prokrete Industries.
    - h. Sikament 300, Sika Corp.
- I. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Q-Set, Conspec Marketing & Manufacturing Co.
    - b. Lubricon NCA, Cormix Construction Chemicals.
    - c. Accelguard 80, Euclid Chemical Co.
    - d. Daraset, W.R. Grace & Co.
    - e. Pozzutec 20, Master Builders, Inc.
    - f. Accel-Set, Metalcrete Industries.
- J. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. PSI-R Plus, Cormix Construction Chemicals.
    - b. Eucon Retarder 75, Euclid Chemical Co.
    - c. Daratard-17, W.R. Grace & Co.
    - d. Pozzolith R, Master Builders, Inc.
    - e. Protard, Prokrete Industries.
    - f. Plastiment, Sika Corporation.

### **2.3 RELATED MATERIALS:**

- A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq.m), complying with AASHTO M 182, Class 2.
- B. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
  - 1. Waterproof paper.
  - 2. Polyethylene film.

3. Polyethylene-coated burlap.

C. Liquid Membrane-Forming Curing Compound: Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I-D, Class A. Moisture loss not more than 0.55 kg/sq.m when applied at 200 sq. ft./gal (4.9 sq.m/L).

1. Products: Subject to compliance with requirements, provide one of the following:

- a. A-H 3 Way Sealer, Anti-Hydro Co., Inc.
- b. Spartan-Cote, The Burke Co.
- c. Conspec #1, Conspec Marketing & Mfg. Co.
- d. Sealco 309, Cormix Construction Chemicals.
- e. Day-Chem Cure and Seal, Dayton Superior Corp.
- f. Eucocure, Euclid Chemical Co.
- g. Horn Clear Seal, A.C. Horn, Inc.
- h. L&M Cure R, L&M Construction Chemicals, Inc.
- i. Masterkure, Master Builders, Inc.
- j. CS-309, W.R. Meadows, Inc.
- k. Seal N Kure, Metalcrete Industries.
- l. Kure-N-Seal, Sonneborn-Chemrex.
- m. Stontop CS2, Stonhard, Inc.

D. Bonding Agent: Polyvinyl acetate or acrylic base.

1. Products: Subject to compliance with requirements, provide of the following:

- a. Acrylic or Styrene Butadiene:
  - 1) Acrylic Bondcrete, The Burke Co.
  - 2) Strongbond, Conspec Marketing and Mfg. Co.
  - 3) Day-Chem Ad Bond, Dayton Superior Corp.
  - 4) SBR Latex, Euclid Chemical Co.
  - 5) Daraweld C, W.R. Grace & Co.
  - 6) Hornweld, A.C. Horn, Inc.
  - 7) Everbond, L&M Construction Chemicals, Inc.
  - 8) Acryl-Set, Master Builders, Inc.
  - 9) Intralok, W.R. Meadows, Inc.
  - 10) Acrylpave, Metalcrete Industries.
  - 11) Sonocrete, Sonneborn-Chemrex.
  - 12) Stonlock LB2, Stonhard, Inc.
  - 13) Strong Bond, Symons Corp.

E. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Burke Epoxy M.V., The Burke Co.
  - b. Spec-Bond 100, Conspec Marketing and Mfg. Co.
  - c. Resi-Bond (J-58), Dayton Superior.
  - d. Euco Epoxy System #452 or #620, Euclid Chemical Co.
  - e. Epoxitite Binder 2390, A.C. Horn, Inc.
  - f. Epabond, L&M Construction Chemicals, Inc.
  - g. Concrecive Standard Liquid, Master Builders, Inc.
  - h. Rezi-Weld 1000, W.R. Meadows, Inc.
  - i. Metco Hi-Mod Epoxy, Metalcrete Industries.
  - j. Sikadur 32 Hi-Mod, Sika Corp.
  - k. Stonset LV5, Stonhard, Inc.
  - l. R-600 Series, Symons Corp.

#### **2.4 PROPORTIONING AND DESIGNING MIXES:**

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
  1. Do not use the same testing agency for field quality control testing.
- B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Engineer.
- C. Design mixes to provide normal weight concrete with the following properties as indicated on drawings and schedules:
  1. 4000 psi (27.6 MPa), 28-day compressive strength; water-cement ratio, 0.45 maximum (air-entrained for Type II cement).
- D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
  1. Sign Bases: Not more than 4 inches (100 mm).
- E. Fiber Reinforcement: Add at manufacturer's recommended rate but not less than 1.5 lb/cu.yd. (0.9 kg/cu.m).

#### **2.5 ADMIXTURES:**

- A. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
- B. Use accelerating admixture in concrete placed at ambient temperatures below 50 deg F (10 deg C).

- C. Use high-range water-reducing admixture in pumped concrete.
- D. Use air-entraining admixture in all concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:
  - 1. 6.0 percent (severe exposure) for 3/4 inch (19 mm) maximum aggregate.
- E. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

## **2.6 CONCRETE MIXING:**

- A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.
  - 1. When air temperature is between 85 deg F (29 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

## **PART 3 - EXECUTION**

### **3.1 GENERAL:**

- A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

### **3.2 FORMS:**

- A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:
  - 1. Provide Class A tolerances for concrete surfaces exposed to view.
  - 2. Provide Class C tolerances for other concrete surfaces.
- B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.

- D. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

### **3.3 PREPARING FORM SURFACES:**

- A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.
- B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

### **3.4 CONCRETE PLACEMENT:**

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.
- C. Deposit concrete continuously in single layer of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness.
- D. Placing Concrete: Deposit and consolidate concrete in a continuous operation.
  - 1. Consolidate concrete during placement operations to that concrete is thoroughly worked into corners.
  - 2. Bring surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb pavement surfaces prior to beginning finishing operations.
- E. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
- F. When air temperatures has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
  - 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

2. Do not use calcium chloride, salt or other materials containing antifreezing agents or chemical accelerators unless otherwise accepted in mix designs.
- G. Hot-Weather Placement: When hot weather conditions exist that would impair quality or strength of concrete, place concrete complying with ACI 305 and as specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Fog spray forms and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
  3. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Engineer.

### **3.5 CONCRETE FINISHES:**

- A. Nonslip Broom Finish: Apply a nonslip broom finish to exposed to view exterior concrete as indicated.
1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

### **3.6 CONCRETE CURING AND PROTECTION:**

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
- C. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.
- D. Provide moisture curing by the following methods:
1. Keep concrete surface continuously wet by covering with water.
  2. Use continuous water-fog spray.

3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4 inch (100 mm) lap over adjacent absorptive covers.
- E. Provide moisture-retaining cover curing as follows:
1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches (75 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- F. Apply curing compound as follows:
1. Apply curing compound to concrete as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

### **3.7 REMOVING FORMS:**

- A. General: Formwork may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

### **3.8 REUSING:**

- A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Engineer.

### **3.9 CONCRETE SURFACE REPAIRS:**

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Engineer.
- B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh (1.2 mm) sieve, using only enough water as required for handling and placing.
1. Cut out honeycombs, rock pockets, voids over 1/4 inch (6 mm) in any dimension, and holes left by tie rods and bolts down to solid

concrete but in no case to a depth less than 1 inch (25 mm). Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.

2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

C. Repair methods not specified above may be used, subject to acceptance of Engineer.

### **3.10 QUALITY CONTROL TESTING DURING CONSTRUCTION:**

- A. General: The Contractor will employ a testing agency to perform tests and to submit test reports.
- B. Sampling and testing for quality control during concrete placement may include the following, as directed by Engineer.
  1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
    - a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
    - b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
    - c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
    - d. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
    - e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour plus additional sets for each 50 cu. yd. (38 cu. m) more than the first 25 cu. yd. (19 cu. m) of each concrete class placed in any one day; one specimen tested at

- 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
2. When frequency of testing will provide fewer than five strength tests for a given class of concrete conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
  3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
  4. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi (3.4 MPa).
- C. Test results will be reported in writing to Engineer, Owner, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- E. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

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**SECTION 32 12 16**  
**ASPHALT CONCRETE PAVING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

**1.2 DESCRIPTION:**

- A. Requirements for the performance of the work are contained in the following sections of the 1996 edition of the "Standard Specifications for Street and Utility Construction, City of Sheridan, Wyoming". By reference, these specifications are hereby made a part of these contract documents.

Section 02519	-	Crushed Aggregate Base Course
Section 02521	-	Bituminous Materials
Section 02525	-	Plant Mix Asphalt Pavements

**1.3 ASPHALT ROAD REPAIR:**

- A. See attached detail sheet entitle RESTORATION - ASPHALT PAVEMENT R-3 dated May 1996.

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**SECTION 33 63 00**  
**STEAM ENERGY DISTRIBUTION**

**PART 1 - GENERAL:**

**1.1 DESCRIPTION:**

Underground steam distribution and condensate return piping system located between buildings.

**1.2 DEFINITIONS:**

- A. System: A 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: System that is designed and factory-fabricated by a company specializing in these systems. The system includes pre-fabricated protective enclosures and does not require a concrete trench or tunnel. The pre-engineered system shall include all piping and components to a point at least 150 mm (6 inches) inside the building and manhole walls.
- C. Drainable-Dryable-Testable (DDT) Pre-Engineered Direct-Buried System: A factory-fabricated system including an airtight and watertight outer protective casing, an insulated carrier pipe and an air space between the insulated carrier pipe and the casing. Drains and vents are provided in the ends of the system (in manholes or buildings). The drains allow draining of ground water or condensate that may leak into the air space if there is a failure in the casing or the carrier pipe. The vents allow water vapor to escape and provide an indication of leakage.
- D. Concrete Shallow Trench (Existing): System with removable concrete covers. Carrier pipes are located within trench. Cross-section of trench is sufficient size only for piping, insulation, supports, air space and drainage. No equipment requiring access for operation or maintenance can be located in the trench because there is no access except by removing the heavy concrete covers.
- E. Carrier Pipe: Pipe carrying the steam or condensate.
- F. Casing: Outer protective pipe on pre-engineered systems. Carrier pipe and insulation are within the casing. The casing may also be referenced as the "conduit".
- G. Project Drawings: The project drawings accompanying this specification provide information on:
  - 1. The size of carrier pipes, approximate length, and site location of the system.
  - 2. Routing of the piping on the site.

3. Location of existing manholes and piping therein.
  4. Type of system required - Existing shallow concrete trench, pre-engineered direct-buried.
  5. Details applicable to type of system specified.
  6. Details of manhole and building entrances.
  7. Other pertinent general information.
- H. Pressures: Pressures listed in this section are gage pressure unless otherwise noted.

#### **1.3 RELATED WORK:**

- A. Excavation, shoring and backfill: Section 31 20 11, EARTH WORK.
- B. Concrete work: Section 32 05 23, CAST-IN-PLACE CONCRETE.
- C. Waterproofing of concrete structures: Section 07 11 13 BITUMINOUS DAMPPROOFING.
- D. Cathodic Protection of DDT Pre-Engineered Direct-Buried Systems: Section 26 42 00, CATHODIC PROTECTION

#### **1.4 QUALITY ASSURANCE:**

- A. Approval by Contracting Officer is required of products or services of proposed manufacturers, suppliers and installers.
- B. For pre-engineered direct-buried systems, expansion joints and ball joints, submit certification that:
  1. Manufacturers regularly and currently manufacture the product.
  2. There is a permanent service organization trained by the manufacturer that will provide the required field supervision of the installation of the system or equipment. Submit name and address of the service organization.
- C. The manufacturer of pre-engineered direct-buried distribution system shall design the system to comply with the requirements of these specifications and is responsible for the complete product to be supplied, fabrication, witnessing installation and testing of the system. The complete design of the system shall be prepared, signed and sealed by a Professional Engineer employed by the system manufacturer.
- D. Products Experience Record:
  1. Pre-Engineered Direct-Buried Systems: Shall be manufactured by a company which specializes in these systems and which has been in this business for five or more years.
  2. All Other Products: The designs shall be of current production and have been in satisfactory operation on at least three installations for approximately five years.
- E. Provide a complete installation with all necessary specialties, materials and equipment fully and properly connected and coordinated. Installation shall be fully operational upon completion of work defined and as phased.

- F. Apply and install systems, materials, equipment and specialties in accordance with manufacturer's instructions. Printed instructions shall be available at the site prior to and during construction.
- G. Materials, design, installation and workmanship shall conform to applicable local codes, and to national codes and standards as referenced in this specification.
- H. Manufactured Products:
  - 1. When two or more items serve the same function, they shall be products of one manufacturer.
  - 2. Manufacturers of assemblies of products, which include components made by others, shall assume complete responsibility for final assembled unit.
    - a. All components of an assembled unit need not be products of the same manufacturer.
    - b. Constituent parts that are alike shall be products of a single manufacturer.
    - c. Components shall be compatible with each other and with the total assembly for intended service.
  - 3. All systems and equipment shall be free from defects that would adversely affect the performance, maintainability, or appearance of individual components or overall assembly.
  - 4. Each product shall be designed for the service conditions specified for that product. If no conditions are specified, the product shall be suitable for the actual service conditions.
- I. Manufacturer's Identification: Components of equipment shall bear manufacturer's name or trademark and model number 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. Refer to Part 2 for requirements for pre-engineered direct-buried systems.
- J. Cathodic Protection: Required on DDT pre-engineered direct buried systems. Refer to Section 26 42 00, CATHODIC PROTECTION.

#### **1.5 SUBMITTALS:**

- A. Submit information and materials under this section separate from information and materials submitted under other sections and mark "SUBMITTED UNDER Section 33 63 00, STEAM ENERGY DISTRIBUTION, GROUP \_\_\_\_."
- B. Submit all items listed under each group simultaneously (except for items that can only be submitted during construction and upon completion of construction).

1. Group I, Pre-Engineered Direct-Buried Systems:
  - a. Certification that system manufacturer regularly and currently manufactures direct-buried systems, and that the designs of the system and equipment to be provided for this project conform to specification requirements. This certification shall be an original signed by a principal officer of the manufacturer.
  - b. Complete descriptions and drawings of design of system and materials of construction including component parts, assembly, carrier pipes, casing, anchors, pipe guides, pipe supports, expansion loops, manhole and building wall penetrations, end seals, leak plates, field installation instructions.
  - c. Manufacturer's data sheets on casing coatings. Provide test report that concludes that coating can withstand a minimum 96 hour test at 186 °C (366 °F) without disbonding from the steel jacket.
  - d. A detailed design layout of the system showing the size, type, and location of each component, the design of anchors and building wall penetrations, the design of the transition points to aboveground or other type systems. Also, if applicable, the type and details of the cathodic protection system including dielectric gaskets.
  - e. Manufacturer's quality assurance plan for fabrication, delivery, storage, installation and testing of system.
  - f. Certificate of Qualification from system manufacturer that the manufacturer's field representative regularly performs the specified duties of monitoring the installation of the system and is technically qualified and experienced in the installation of the system and is authorized by the supplier to make and sign the daily reports specified herein.
  - g. Manufacturer's data sheets and thickness of carrier pipe insulation.
  - h. Calculations approved and stamped by Professional Engineer demonstrating that allowable stress of piping will not be exceeded due to thermal expansion and that anchor forces and moments are not excessive. Calculations shall be performed by a finite-element, three dimensional analysis computer program. Final report shall show node stresses, forces, moments and displacements.
  - i. Design life calculations for cathodic protection system. These shall be approved and stamped by NACE-qualified corrosion engineer.
  - j. All drawings and calculations shall have Professional Engineer's stamp.
  - k. A proposed schedule of activities indicating when various items of work and tests are to be carried out and when quality control inspectors of the supplier will be present at the job site.

1. The daily written report from the manufacturer's representative at the job site during all stages of material delivery and construction.
- m. Proposed changes in design due to unforeseen conflicts or interferences along the route of the system.
- n. Upon completion of the work:
  - 1) Certificate of Compliance signed by principal officers of the manufacturer and the contractor certifying that the system has been installed in accordance with contract requirements.
  - 2) Operation and maintenance manual.
  - 3) As-built layout of system.
2. Group II, Piping in Manholes, Concrete Shallow Trenches, Open Areas:
  - a. Pipe, valves, strainers and fittings.
  - b. Steam traps.
  - c. Pipe insulation, jackets, adhesives and cements.
- C. Independent Weld Testing Firm for Carrier Piping in Pre-Engineered Direct-Buried and Concrete Shallow Trench Systems:
  1. Certificate of Qualification of testing firm.
  2. Certificate of Acceptability of actual welds.
- D. Credentials of NACE-qualified firm for testing the cathodic protection. Refer to Section 26 42 00, CATHODIC PROTECTION.

#### **1.6 STORAGE AND HANDLING:**

- A. Equipment and material placed on the job shall remain in the custody of the Contractor until final acceptance whether or not the Government has reimbursed the Contractor for the equipment and material.
- B. The Contractor is solely responsible for the protection of the equipment and material against damage from any source. Protect piping systems against entry of water and mud and all foreign substances by installing watertight protection on open ends at all times. Protect direct-buried system coatings from ultraviolet light (sunlight). Existing equipment worked on by the Contractor or in the Contractor's working area shall be under the custody and responsibility of the Contractor.
- C. All insulated piping systems exposed to water must be replaced with new systems.
- D. Place all damaged items in first class new operating condition or replace damaged items as determined and directed by the COTR (RE)/Contracting Officers Technical Representative (COTR), at no additional cost to the Government.

#### **1.7 JOB CONDITIONS:**

- A. Phasing of demolition and construction shall be coordinated with the COTR.

- B. Interruption of Existing Service: Arrange, phase and perform work and provide temporary facilities, materials, equipment, and connections to utilities, to assure adequate steam and condensate return service for existing installations at all times. Only such absolutely necessary interruptions as may be required for making connections will be permitted, and only at such times when approval is obtained from RE/COTR. Interruptions to steam and condensate service shall be only with prior approval, and be the minimum possible duration.

#### **1.8 APPLICABLE PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Federal Specifications (Fed. Spec.):
- A-A-60005 NOT 1..... Frames, Covers, Grating, Steps, Sump And Catch Basin, Manhole
  - L-P-535E..... Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) and Poly (Vinyl Chloride-Vinyl Acetate)
  - L-S-125B..... Screening, Insect, Nonmetallic
- C. Military Specifications (Mil. Spec.):
- MIL-S-901D..... Shock Tests. H.I. (High Impact) Shipboard Machinery, Equipment and Systems
- D. ASTM International (ASTM):
- A36/A36M-04..... Structural Steel
  - A47/A47M-99..... Ferritic Malleable Iron Castings
  - A53/A53M-02..... Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
  - A105/A105M-03..... Carbon Steel Forgings for Piping Applications
  - A106/A106M-04..... Seamless Carbon Steel Pipe for High-Temperature Service
  - A126-95(2001)..... Gray Iron Castings for Valves, Flanges and Pipe Fittings
  - A134-96(2001)..... Pipe, Steel, Electric-Fusion(Arc)-Welded (Sizes NPS 16 and over)
  - A135-01..... Electric-Resistance Welded Steel Pipe
  - A139/A139M-04..... Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and over)
  - A167-99..... Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
  - A193/193M-03..... Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service

A194/194M-03b..... Carbon and Alloy Steel Nuts for Bolts for High-  
 Pressure or High-Temperature Service, or Both  
 A197/A197M-00..... Cupola Malleable Iron  
 A216/A216M-93(2003).... Steel Castings, Carbon, Suitable for Fusion  
 Welding, for High-Temperature Service.  
 A234/A234M-03..... Pipe Fittings of Wrought Carbon Steel and Alloy  
 Steel for Moderate and High Temperature Service  
 A240/A240M-04ae1..... Chromium and Chromium-Nickel Stainless Steel  
 Plate, Sheet and Strip for Pressure Vessels and  
 for General Applications  
 A395/A395M-99..... Ferritic Ductile Iron Pressure-Retaining Castings  
 for Use at Elevated Temperatures  
 A536-84(1999)e1..... Ductile Iron Castings  
 B61-02..... Steam or Valve Bronze Castings.  
 B209-04..... Aluminum and Aluminum-Alloy Sheet and Plate  
 C411-97..... Hot-Surface Performance of High-Temperature  
 Thermal Insulation  
 C449/C449M-00..... Mineral Fiber Hydraulic-Setting Thermal Insulating  
 and Finishing Cement  
 C533-00..... Calcium Silicate Block and Pipe Thermal Insulation  
 C547-03..... Mineral Fiber Pipe Insulation  
 C552-03..... Cellular Glass Thermal Insulation  
 C591-01..... Unfaced Preformed Rigid Cellular Polyisocyanurate  
 Thermal Insulation  
 C655-02..... Reinforced Concrete D-Load Culvert, Storm Drain  
 and Sewer Pipe  
 C920-02..... Elastomeric Joint Sealants  
 C1126-03..... Faced or Unfaced Rigid Cellular Phenolic Thermal  
 Insulation  
 C1136-03a..... Flexible, Low Permeance Vapor Retarders for  
 Thermal Insulation  
 D1784-03..... Rigid Poly (Vinyl Chloride)(PVC) Compounds and  
 Chlorinated Poly (Vinyl Chloride)(CPVC) Compounds  
 D2310-01..... Machine-Made "Fiberglass" (Glass-Fiber Reinforced  
 Thermosetting-Resin) Pipe  
 D2487-00..... Soils for Engineering Purposes (Unified  
 Classification System)  
 D2996-01..... Filament-Wound Fiberglass (Glass-Fiber-Reinforced-  
 Thermosetting-Resin) Pipe  
 E. American Society of Mechanical Engineers (ASME):  
 B16.3-98..... Malleable Iron Threaded Fittings

- B16.5-03..... Pipe Flanges and Flanged Fittings NPS ½ - 24
- B16.9-03..... Factory-Made Wrought Buttwelding Fittings
- B16.11-01..... Forged Fittings, Socket-Welding and Threaded
- B31.1-04..... Code for Pressure Piping, Power Piping, with  
Amendments
- B31.9-96..... Code for Pressure Piping, Building Services  
Piping, with Amendments
- B40.100 (2000)..... Pressure Gauges and Gauge Attachments
- Boiler and Pressure Vessel Code, Section VIII: 2004 Edition, with  
Amendments
- F. American Welding Society (AWS):
  - AWS B2.1-00..... Welding Procedure and Performance Qualification
- G. Manufacturers Standardization Society of the Valve and Fitting Industry  
(MSS):
  - SP45-03..... By-Pass and Drain Connection Standard
  - SP58-02..... Pipe Hangers and Supports-Materials, Design and  
Manufacture
  - SP69-02..... Pipe Hangers and Supports-Selection and  
Application
  - SP80-03..... Bronze Gate, Globe, Angle and Check Valves
- H. National Fire Protection Association (NFPA):
  - 255-00..... Test of Surface Burning Characteristics of  
Building Materials
- I. American Society of Heating, Refrigerating and Air Conditioning Engineers  
(ASHRAE):
  - ASHRAE Handbook..... 2004 HVAC Systems and Equipment
- J. American Concrete Institute (ACI):
  - 318/318R-02..... Building Code Requirements for Reinforced Concrete
- K. NACE International (Corrosion Engineers) (NACE):
  - RP0169-02..... Standard Recommended Practice, Control of External  
Corrosion on Underground or Submerged Metallic  
Piping Systems
- L. Expansion Joint Manufacturers Association (EJMA):
  - 8th Edition-2003..... Standards of the Expansion Joint Manufacturers  
Association
- M. American Association of State Highway and Transportation Officials  
(AASHTO):
  - M300-03..... Inorganic Zinc Rich Primer
- N. Society for Protective Coatings (SSPC):
  - SP-10/NACE No. 2-2000.. Near White Blast Cleaning

O. Unified Facilities Guide Specifications (UFGS):

UFGS-02552A..... Pre-Engineered Underground Heat Distribution  
System (January 2004 or later)

**PART 2 - PRODUCTS:**

**2.1 PRE-ENGINEERED, FACTORY-FABRICATED, DIRECT-BURIED, DRAINABLE-DRYABLE-  
TESTABLE (DDT) SYSTEMS:**

A. Design Pressure and Temperature: All components of system shall be  
suitable for carrier pipe pressures and temperatures as follows:

1. Steam System: 1000 kPa (150 psi); 185 °C (366 °F).
2. Condensate System: 345 kPa (50 psi); 154 °C (310 °F).

B. Description of System Design: Refer to Part 1, "DEFINITIONS".

C. Steam Carrier Pipes: Refer to Article, "STEAM PIPING".

D. Condensate Carrier Pipes: Refer to Article, "STEAM CONDENSATE PIPING". Do  
not locate condensate pipes in casings (conduits) that contain steam  
pipes.

E. Carrier Pipe Insulation:

1. Conform to minimum thickness and type of insulation listed in Tables 1  
and 2 below as required for service temperature in carrier pipe as  
listed below.
2. HPS: Steam temperature is (365°F), steam pressure is (150 psi). Pumped  
condensate temperature is (200 °F). Drip return temperature is  
(212 °F).
3. MPS: Steam temperature is (300°F), steam pressure is (50 psi). Pumped  
condensate temperature is 93 °C (200 °F). Drip return temperature is  
100 °C (212 °F).
4. LPS: Steam temperature is 250 °F, steam pressure is (15 psig). Pumped  
condensate temperature is (200 °F). Drip return temperature is (212  
°F).
5. Insulation Banding and Jacket: Stainless steel bands and clips, at  
least 13 mm (0.5 inches) wide, ASTM A-167 (304 stainless steel),  
maximum spacing 460 mm (18 inches). A minimum of two bands is required  
for each 1300 mm (4 foot) section of insulation. Vinyl-coated  
fiberglass scrim jacket, Fed. Spec. L-S-125, Type II, Class 2, with 18  
x 16 mesh (number of filaments per inch) and made of 0.335 mm (0.013  
inches) diameter vinyl-coated fibrous glass yarn. Install bands over  
the jacket to secure the insulation to the carrier pipe.

6. Allowable Carrier Pipe Insulation Type and Minimum Insulation Thickness:

<p>TABLE 1 Minimum Pipe Insulation Thickness mm (inches) For Steam 110 to 2800 kPa (16 to 408 psi) gage</p>			
Nominal Pipe Diameter mm (inches)	MPT-PC MPT-PF	Delta	Thermo-12 Super Caltemp
25 (1)	50 (2)	63 (2 1/2)	100 (4)
40 (1 1/2)	50 (2)	63 (2 1/2)	100 (4)
50 (2)	63 (2 1/2)	85 (3 1/2)	110 (4 1/2)
65 (2 1/2)	63 (2 1/2)	85 (3 1/2)	110 (4 1/2)
80 (3)	75 (3)	100 (4)	125 (5)
100 (4)	75 (3)	100 (4)	125 (5)
125 (5)	75 (3)	100 (4)	125 (5)
150 (6)	85 (3 1/2)	110 (4 1/2)	135 (5 1/2)
200 (8)	85 (3 1/2)	110 (4 1/2)	135 (5 1/2)
250 (10)	100 (4)	125 (5)	150 (6)
300 (12)	100 (4)	125 (5)	150 (6)
350 (14)	100 (4)	125 (5)	150 (6)
400 (16)	100 (4)	125 (5)	150 (6)
450 (18)	100 (4)	125 (5)	150 (6)

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

<p>TABLE 2 Minimum Pipe Insulation Thickness mm (inches) For Steam Less than 110 kPa (16 psi) gage, Condensate Return</p>			
Nominal Pipe Diameter mm (inches)	MPT-PF MPT-PC	Delta	Thermo-12 Super Caltemp
25 (1)	35 (1 1/2)	50 (2)	75 (3)
40 (1 1/2)	35 (1 1/2)	50 (2)	75 (3)
50 (2)	35 (1 1/2)	50 (2)	75 (3)
65 (2 1/2)	35 (1 1/2)	50 (2)	75 (3)
80 (3)	50 (2)	63 (2 1/2)	85 (3 1/2)
100 (4)	50 (2)	63 (2 1/2)	85 (3 1/2)
125 (5)	50 (2)	63 (2 1/2)	85 (3 1/2)
150 (6)	63 (2 1/2)	76 (3)	110 (4.5)
200 (8)	63 (2 1/2)	76 (3)	110 (4.5)

<p style="text-align: center;">TABLE 2 Minimum Pipe Insulation Thickness mm (inches) For Steam Less than 110 kPa (16 psi) gage, Condensate Return</p>			
Nominal Pipe Diameter mm (inches)	MPT-PF MPT-PC	Delta	Thermo-12 Super Caltemp
250 (10)	76 (3)	100 (4)	125 (5)
300 (12)	76 (3)	100 (4)	125 (5)
350 (14)	76 (3)	100 (4)	125 (5)
400 (16)	76 (3)	100 (4)	125 (5)
450 (18)	76 (3)	100 (4)	125 (5)

Notes: Insulation listed has passed the 96-hour boiling water test.  
Pipes smaller than 25 mm (1 inch) shall have the same insulation thickness as required for 25 mm (1 inch) pipe.  
Delta is available from Rockwool, Leeds, AL.  
MPT is available from Mineral Products of Texas, Houston, TX.  
Thermo-12 and Super Caltemp is available from Johns-Manville, Denver, CO.

- F. Casing: Smooth-wall steel, electric resistance welded, conforming to ASTM A134, ASTM A135, or ASTM A139. 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.

Casing Diameter mm (in.)	Minimum Thickness mm (in.)
150 - 1170 (6 - 46)	6.35 (0.250)

- G. Casing End Seal Plates with Vents and Drains: ASTM A36 steel, minimum thickness 9.5 mm (0.375 inches) for casings up thru 300 mm (12 inches) diameter and 13 mm (0.5 inches) for casings over 300 mm (12 inches) diameter. Provide 25 mm (one inch) drain at the bottom and vent at the top. Construct with threaded steel half couplings. Install threaded brass plugs in drains. Install vent riser pipes, ASTM A53, Schedule 40, galvanized, extending through top of manhole and terminate 300 mm (12 inches) above grade with 180-degree bend.
- H. Gland Seals: Not permitted because of the possibility of water entering the system thru the gland seal from a flooded manhole.
- I. Air Space: Provide continuous 25 mm (one inch) minimum air space between carrier pipe insulation and casing.
- J. Casing Coating: Dual layers of fusion-bonded epoxy, inner green-colored layer minimum thickness 0.5 mm (0.020 inches), outer black-colored layer

minimum thickness 0.25 mm (0.010 inches). Rated by coating manufacturer for continuous service for at least 25 years at minimum temperature of 110 °C (230 °F) and having a coefficient of expansion similar to that of steel. Coating shall be applied in accordance to recommendations of coating manufacturer including surface preparation. Factory-inspect for holidays and make repairs as necessary.

- K. Coating of End Plates and Casing (Conduit) Sections Extending in Manholes: Zinc-rich coating that conforms to AASHTO M300, Type IA except that volatile organic compounds shall not exceed 0.34 kg per liter (2.8 pounds per gallon). 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.
- L. Carrier Pipe Guides and Supports: Maximum spacing 3000 mm (10 feet) on centers, no more than 1500 mm (5 feet) 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.
- M. Anchor Plates: ASTM A36 steel, welded to carrier pipe and casing, 13 mm (0.5 inches) 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 900 to 1500 mm (3 to 5 feet) from piping entrance to manhole or building wall. Walls of manholes and buildings cannot be utilized as anchor points.
- N. Field Connection of Casing Sections: 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 1.3 mm (0.05 inch) minimum thickness polyethylene shrink sleeve designed for a service temperature exceeding 80 °C (176 °F).
- O. Manhole and Building Wall Penetrations: Provide steel leak plates welded to wall sleeves or to casings. Where wall sleeve is utilized, allow sufficient annular space between the sleeve and the casing and install a watertight EPDM Link-Seal (Thunderline Corp) or equal, rated for 121 °C

(250 °F) minimum. Manhole and building walls cannot be used as anchor points.

- P. Cathodic Protection: Provide sacrificial anode type system with dielectric isolation devices and test stations for all systems. Design system for 25 years service, assume two percent bare metal. System shall comply with NACE RP0169 and shall conform to Section 26 42 00, CATHODIC PROTECTION.
- Q. Manufacturer's Identification: 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.
- R. Branch Piping Connections: All branch piping connections must be located in manholes.
- S. Manufacturers: Perma-Pipe, Rovanco, Thermacor, or equal.

## **2.2 CONCRETE SHALLOW TRENCHES (EXISTING):**

- A. Waterproofing: Apply as specified to all below grade portions of the trench. Conform to Section 07 11 13, BITUMINOUS DAMPPROOFING.
- B. Gaskets and sealants: Provide 6 mm (1/4 inch) thick neoprene pad with a minimum width of 50 mm (2 inches) between covers and tops of walls. All trench joints must be sealed with ASTM C920 elastomeric sealants that are available as a one or two component system. Asphaltic sealants are not permitted. Sealants must resist 50% total joint movement. Non-sagging sealant must be used for vertical joints. Self-leveling sealant must be used for trench top butt joints. Sealant shall be NPC Bidco C-56 or approved Equal by COTR.

## **2.3 STEAM CARRIER PIPING:**

- A. Pipe: Steel; seamless, ASTM A53, Grade B or ASTM A106, Grade B; electric resistance welded ASTM A53, Grade B; Schedule 40. Standard weight permitted for pipe sizes 300 mm (12 inches) and above. Grade F, furnace butt-welded pipe, is not permitted.
- B. Joints:
  - 1. In trenches and direct-buried systems: Butt-weld except socket-weld for pipe sizes two-inches and below. Manufacturer's standard sliding gasketed joints permitted between sections of WSL pre-engineered direct-buried systems. No joints allowed in factory-fabricated straight sections of pre-engineered direct-buried systems.
  - 2. In tunnels, manholes and open areas: Butt-weld pipe sizes 65 mm (2-1/2 inches) and above; thread or socket-weld pipe sized 50 mm (two inches) and below.

C. Fittings:

1. Butt-Welded Joints: Steel, ASTM A234, Grade B, ASME B16.9, 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.
2. Threaded Joints: Malleable iron, ASTM A47 or A197, ASME B16.3, 2050 kPa (300 pound) class.
3. Socket-Welded Joints: Forged steel, ASME B16.11, 13,800 kPa (2000 psi) class.

D. Flanges and Bolts: Weld neck, ASME B16.5, forged steel, ASTM A105. Pressure class 1025 kPa (150 psi). Bolts shall be high strength ASTM A193, Class 2, Grade B8. Nuts shall be ASTM A194.

E. Unions: On pipe 50 mm (two inches) and smaller, threaded, malleable iron or steel, 2050 kPa (300 psi) class.

**2.4 STEAM CONDENSATE CARRIER PIPING:**

A. Pipe: Seamless, ASTM A53, Grade B or ASTM A106, Grade B; electric resistance welded ASTM A53, Grade B; Schedule 80. Grade F, furnace butt-welded, pipe is not permitted.

B. Joints:

1. In Trenches and direct-buried systems: Butt-weld except socket-weld is required for pipe sizes 50 mm (two inches) and below. Manufacturer's standard sliding, gasketed joints permitted between factory-fabricated sections of direct buried WSL system. No joints allowed in factory-fabricated straight sections of pre-engineered direct-buried systems.
2. In Manholes and Open Areas: Butt-weld pipe sizes 65 mm (2-1/2 inches) and above; thread or socket-weld for pipe sizes 50 mm (two inches) and below.

C. Fittings:

1. Welded Joints: Steel, ASTM A234, Grade B, ASME B16.9, same schedule as adjoining pipe.
2. Threaded Joints: Malleable iron, ASTM A47 or A197, ASME B16.3, 2050 kPa (300 psi) class.
3. Socket-Welded Joints: Forged steel, ASME B16.11, 13,800 kPa (2000 psi) class.

D. Unions (Except in Trenches): On piping 50 mm (two inches) and under, 2050 kPa (300 psi) malleable iron or steel.

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

## 2.5 EXPANSION LOOPS AND BENDS:

- A. Stresses shall be 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 1000 kPa (150 psi) and 185 °C (366 ° F) for steam line loops and bends and 345 kPa (50 psi) and 154 °C (310 °F) for condensate return line loops and bends. Base calculations on actual pressures and temperatures if they are higher than those listed above.
- B. For low pressure steam systems 100 kPa (15 psi) and less, base calculations for steam and condensate on 100 kPa (15 psi) and 121 °C (250 °F) and comply with Building Services Piping Code (ASME B31.9).

## 2.6 VALVES:

- A. Valves for particular services are generally specified as Type Numbers. The Type Numbers are defined below. All valves of the same type shall be the products of a single manufacturer and shall comply with MSS SP45, MSS SP80 and ASME B31.1. Design valves for the service fluids and conditions. Pressure - temperature ratings listed are minimum requirements. Packing and gaskets must be asbestos-free.
- B. Valve Type Designations:
  - 1. Gate Valves:
    - a. Type 101: Cast steel body ASTM A216 WCB, rated 1025 kPa (150 psi) at 260 °C (500 °F), 11-1/2 to 13 percent chromium stainless steel flexible wedge and hard faced (stellite) or nickel-copper alloy seats, 1025 kPa (150 psi) ASME flanged ends, OS&Y, rising stem, bolted bonnet.
      - 1) Provide factory installed globe valved bypass on all steam valves larger than 80 mm (3 inches). Conform to MSS SP45.
      - 2) Drill and tap bosses for connection of drains where shown. Conform to MSS SP45.
    - b. Type 103: Cast iron body ASTM A126 Class B, rated for 850 kPa (125 psi) saturated steam, 1375 kPa (200 psi) WOG, bronze or bronze faced wedge and seats, 850 kPa (125 psi) ASME flanged ends, OS&Y, rising stem, bolted bonnet, renewable seat rings.
    - d. Type 104: Bronze body ASTM B61, rated for 1375 kPa (200 psi) saturated steam, 2750 kPa (400 psi) WOG, bronze wedges and Monel or stainless steel seats, threaded ends, rising stem, union bonnet.
    - e. Type 105: Not used.

- f. Type 106: Forged steel body ASTM A105, rated for 2050 kPa (300 psi) at 216 °C (420 °F) minimum (Class 4130 kPa (600 psi) or Class 5500 kPa (800 psi)), hardened stainless steel or stellite wedge and seats, threaded ends, OS&Y, rising stem, bolted bonnet.
2. Check valves:
    - a. Type 401: Cast steel body ASTM A216, swing-type, rated for 1025 kPa (150 psi) at 260 °C (500 °F), stainless steel or stainless steel - faced disc and seat, 1025 kPa (150 psi) ASME flanged ends, bolted cover, renewable disc.
    - b. Type 402: Not used.
    - c. Type 403: Cast iron body ASTM A126 Class B, swing-type, rated for 850 kPa (125 psi) saturated steam, 1375 kPa (200 psi) WOG, bronze or bronze-faced disc and seat, 850 kPa (125 psi) ASME flanged ends, bolted cover, renewable disc and seat.
    - d. Type 404: Bronze body ASTM B61, swing-type, rated for 1375 kPa (200 psi) saturated steam, 2750 kPa (400 psi) WOG, bronze disc, threaded ends, regrinding disc.
  3. Ball valves: Reduced port permitted for bypass (throttling) service, full port required for all other services, one-fourth turn to open.
    - a. Type 501: Not used.
    - b. Type 502: Bronze body, rated for 1025 kPa (150 psi) at 185 °C (365 °F), 1725 kPa (250 psi) at 121 °C (250 °F); reinforced TFE seat, stem seal and thrust washer; end entry, threaded ends, one-fourth turn to open.
    - c. Type 503: Not used.
    - d. Type 504: Carbon steel or ASTM A536 ductile iron body, saturated steam service, rated for 1030 kPa (150 psi), stainless steel ball and stem, Polyfil seat, live-loaded stem seal, 1025 kPa (150 psi) ASME flanged ends. Manufacturer: American, Worcester, or equal.
- C. Valve Applications (Steam Lines):
1. Gate valves, 50 mm (two inches) and under: Type 106.
  2. Gate valves, 65 mm (2-1/2 inches) and above: Type 101.
  3. Check valves, 50 mm (two inches) and under: Type 404.
  4. Check valves, 65 mm (2-1/2 inches) and above: Type 401.
  5. Ball valves, 50 mm (two inches) and under: Type 502
  6. Ball valves, 65 mm (2-1/2 inches) and above: Type 504.
- D. Valve Applications (Condensate Lines):
1. Gate valves, 50 mm (two inches) and under: Type 104.
  2. Gate valves, 65 mm (2 1/2 inches) and above: Type 103.
  3. Check valves, 50 mm (two inches) and under: Type 404.

4. Check valves, 65 mm (2 1/2 inches) and above: Type 403.
5. Ball valves, 50 mm (two inches) and under: Type 502.
6. Ball valves, 65 mm (2-1/2 inches) and above: Type 504.

## **2.7 STEAM TRAPS:**

- A. Application: Steam line drip points. Each type furnished by a single manufacturer.
- B. Type: Inverted bucket type with thermostatic vent in bucket, except closed-float-thermostatic on discharge side of pressure reducing stations. Select the traps for pressures as shown or required.
- C. Bodies: Cast iron or stainless steel. Construction shall permit ease of removal and servicing working parts without disturbing connecting piping.
- D. Floats: Stainless steel.
- E. Valves: Hardened chrome steel.
- F. Mechanism and Thermostatic Element: Stainless steel mechanisms. Bi-metallic air vent on inverted bucket traps.
- G. Identification: 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.
- H. Factory-Packaged Trap Station: As an option for drip points requiring isolating valves, strainer, trap, and valved test connection, provide factory-packaged trap station including these features. Manufacturer: Spirax-Sarco, Armstrong.

## **2.8 STRAINERS, Y-TYPE:**

- A. Provide as shown on steam and condensate piping systems.
- B. Type: Open-end removable cylindrical screen; threaded blow-off connection.
- C. Construction:
  1. Steam Service to 1025 kPa (150 psi) and at Drip Traps: Rated for minimum 1025 kPa (150 psi) saturated steam. Rated for 1025 kPa (150 psi) ASME flanged ends, cast steel, for pipe sizes above 50 mm (two inches). Cast iron or bronze, rated for 1725 kPa (250 psi) saturated steam, threaded ends, for pipe sizes 50 mm (two inches) and under.
  2. Condensate Service: Rated for 850 kPa (125 psi) saturated steam, 1200 kPa (175 psi) WOG. Provide 850 kPa (125 psi) ASME flanged ends, cast iron, for pipe sizes above 50 mm (two inches). Provide cast iron or bronze, threaded ends, for pipe sizes 50 mm (two inches) and under.
- D. Screen: Monel or stainless steel, free area not less than 2-1/2 times flow area of pipe. Diameter of openings shall be 1.3 mm (0.05 inch) or less on steam service and 1.5 mm (0.06 inch) or less on water service.

## **2.9 PIPE HANGERS AND SUPPORTS:**

- A. 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, 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.

- B. Standards: Comply with recommendations and requirements of MSS SP-58, MSS SP-69, ASME B31.1.
- C. Design:
  - 1. Components: Factory-built products of a manufacturer whose principle business is pipe supports. All components must have published load ratings. For concrete trenches, non-factory built products that comply with details shown on the contract drawings may also be utilized.
  - 2. Roller Hangers and Sliding Supports: Provide on all systems subject to horizontal movement due to thermal expansion except when long hanger rods permit sufficient horizontal movement. If vertical angle of hanger rod exceeds four degrees, rollers or sliders are required.
  - 3. All support assemblies from above shall include threaded connections that permit vertical position adjustment.
- D. Upper Attachments to Structure: MSS SP-58, Type 18, 20, 21, 22, 23, 29, and 30.
- E. Roller Supports: MSS SP-58, Types 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, and 33.
- H. Pipe Stands: MSS SP-58, Type 38.
- I. Riser Clamp: MSS SP-58, Type 42.
- J. Alignment Guides: Construct guides of welded steel as shown to restrain movement perpendicular to the long axis of the piping. If not shown, provide steel spider clamped to pipe, enclosed within steel sleeve that is bolted or welded to structural support. Spider-type guide shall be a standard manufactured product. Design to withstand lateral force equal to minimum of 15 percent of anchor loading.
- K. Trapeze Supports: May be used where pipes are close together and parallel. Construct with 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. All supports, including all structural steel, in trenches and manholes shall be hot-dip galvanized.

## **2.10 PIPE ANCHORS:**

Provide as shown. Construct with all welded steel, ASTM A36.

## **2.11 INSULATION MATERIALS (IN EXISTING MANHOLES, CONCRETE TRENCHES, OPEN AREAS):**

- A. Calcium Silicate Insulation:
  - 1. Preformed Piping Insulation: ASTM C533, Type I.
  - 2. Blocks: ASTM C533, Type I.
  - 3. Fitting Insulation: ASTM C533, with polyvinyl chloride, Fed. Spec. L-P-535, Type II Grade GU, and Type III, premolded fitted covering 0.5 mm (0.020 inches) thick.
- B. Fiberglass Insulation:
  - 1. Preformed Piping Insulation: ASTM C547, 230 °C (450 °F).
  - 2. Fitting Insulation: ASTM C547, 230 °C (450 °F), with polyvinyl chloride, Fed. Spec. L-P-535, Type II Grade GU, and Type III, premolded fitted covering 0.5 mm (0.020 inches) thick.
- C. Cellular Glass Insulation: Preformed Piping Insulation: ASTM C552.
- D. Insulating and Finishing Cements: Best grade recommended by printed instructions of manufacturer for the type of insulation system and service conditions. Conform to ASTM C449.
- E. Insulation Bands: Minimum 12 mm (1/2 inch) wide by 0.4 mm (0.015 inch) thick ASTM A167 stainless steel.
- F. Aluminum Jackets: Minimum 0.4 mm (0.016 inch) thick aluminum, ASTM B209, 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 20 mm (0.75 inch) wide on 450 mm (18 inch) centers. Bands shall be applied with manufacturers recommended sealant. Entire system shall be watertight.
- G. All-Service Jackets: White kraft bonded to 0.025 mm ((0.001 inch) thick aluminum foil, fiberglass reinforced, pressure sensitive adhesive closure. Beach puncture 50 units, suitable for painting without sizing. Comply with ASTM C1136. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and not less than 100 mm (4 inch) 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.

- H. Glass Cloth Jacket: Minimum 0.24 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psi) bursting strength, weathertight for outside service. Beach puncture 50 units.
- I. Pipe Covering Protection Saddles: MSS SP-58, Type 39 at all hanger points except where Type 3 pipe clamps are provided.
- J. Fire and Smoke Ratings: Assembled insulation systems shall meet flame spread (25) and smoke developed (50) ratings as developed under ASTM C411 and NFPA 255 standards and specifications.

#### **2.12 PIPE AND VALVE FLANGE GASKETS:**

Non-asbestos, designed for the service conditions. On steam service utilize "Flexitallic" spiral-wound, "Lamons Grafoil Grade GHR", "Lamons Spira-wound", "Garlock ST-706", or equal.

#### **2.13 BURIED UTILITY WARNING TAPE:**

Tape shall be 0.1 mm (0.004 inch) thick, 150 mm (6 inches) wide, yellow polyethylene with a ferrous metallic core, acid and alkali-resistant and shall have a minimum strength of 12,000 kPa (1750 psi) lengthwise and 10,300 kPa (1500 psi) 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. Connecting to Existing Work: 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. Work disturbed or damaged shall be replaced to its prior condition. Piping connections shall be made only in manholes or buildings.
- B. Coordination: 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.
- C. Excavation, trenching, shoring, sheathing, bracing, and backfilling shall conform to Section EARTH WORK.
- D. Grading: Unless otherwise shown on drawings, steam lines shall be graded downward not less than 50 mm in 12 meters (two inches in 40 feet) 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 or buildings.

### **3.2 DEMOLITION:**

- A. Perform work in accordance with requirements for phasing.
- 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 within one week 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 COTR.

### **3.3 PIPING JOINTS AND FITTINGS:**

- A. Welded Joints:
  - 1. 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.
  - 2. Clean pipe and fittings before welding and installation in system.
- B. Threaded Joints:
  - 1. Pipe threads shall be cut to give proper engagement in threaded fittings. Threaded pipe shall have clean-cut threads; dull or damaged pipe dies shall not be used.
  - 2. Clean pipe and fittings before installation and ream pipe after cutting threads. Joints shall be made with oil and graphite pipe joint compound applied to male threads only.
- C. Fittings: All pipe intersections and all changes in direction shall be made with factory-built-reinforced fittings. Field-fabricated fittings and miters are not permitted.
- D. Flanged Joints: 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.

### **3.4 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.

### 3.5 WELDING:

- A. The Contractor is entirely responsible for the quality of the welding and shall:
  - 1. Conduct tests of the welding procedures used by his organization, determine the suitability of the procedures used, determine that the welds made will meet the required tests, and also determine that the welding operators have the ability to make sound welds under standard conditions.
  - 2. Comply with ASME B31.1 and AWS B2.1.
  - 3. Perform all welding operations required for construction and installation of the heat-distribution system.
- B. Qualification of Welders: Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1 and AWS B2.1, and also as outlined below.
- C. Examining Welder: Examine each welder at job site, in the presence of the COTR (RE)/Contracting Officer's Technical Representative (COTR), to determine the ability of the welder to meet the qualifications required. Test welders for piping for all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall be:
  - 1. Allowed to weld only in the position in which he has qualified.
  - 2. Required to identify his welds with his specific code marking signifying his name and number assigned.
- D. Examination Results: Provide the RE/COTR with a list of names and corresponding code markings. Retest welders that fail to meet the prescribed welding qualifications. Disqualify welders, who fail the second test, for work on the project.
- E. Beveling: Field bevels and shop bevels shall be 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.
- F. Alignment: Utilize split welding rings or approved alternate method for field joints on all carrier pipes above 50 mm (two inches) to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe. Make field joints 50 mm (two inches) and smaller with welding sockets.
- G. Erection: Piping shall not be split, bent, flattened, or otherwise damaged either before, during, or after installation. Where the pipe temperature falls to 0 °C (32 °F) or lower, the pipe shall be heated to approximately 38 °C (100 °F) for a distance of 300 mm (one foot) on each side of the

weld before welding, and the weld shall be finished before the pipe cools to 0 °C (32 °F).

- H. Defective Welds: 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.
- I. Electrodes: 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.

### **3.6 DRAIN VALVES AND VENT VALVES:**

Provide 40 mm (1-1/2") minimum pipe size drain valves on condensate return carrier pipes at all low points in manholes. Provide 25 mm (1") minimum air vent valves in manholes at all high points in condensate return carrier piping.

### **3.7 PIPE SUPPORT INSTALLATION (IN TRENCHES AND MANHOLES):**

- A. Coordinate support locations with structure prior to erection of piping. Arrangement of supports shall facilitate operating, servicing and removal of valves, strainers, and piping specialties.
- B. 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 directed by the RE/COTR.
  - 3. Do not attach pipe supports, hangers, clamps or anchors to equipment unless specified for that equipment or unless the RE/COTR gives written permission.

### **3.8 DIRECT-BURIED SYSTEM INSTALLATION:**

- A. The system manufacturer shall oversee the delivery, storage, installation and testing of the system. All work shall be in strict accordance with the requirements specified herein and with the printed instructions of the manufacturer. Printed instructions must be available at the 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 system designer and the RE/COTR. 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 and as specified in Section EARTH WORK. Beach sand or any sand with large amounts of chlorides is not permitted. Place system on a 300 mm (12 inch) thick sand bed and backfill on all sides with 150 mm (6 inch) thick sand as

measured from outside the casing. Foundation for system must be firm and stable. Foundation and backfill must be free from rocks or substances that could damage the system coating. 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. Representative of System Manufacturer: This shall be a person who regularly performs the duties listed below, is certified in writing by the system manufacturer to be technically qualified and experienced in the installation of the system, and shall be authorized by the manufacturer to make and sign the daily reports specified herein. The representative shall be present at the job site when the following types of work are being performed:

1. Inspection and unloading of material delivered to site.
2. Inspection of trench prior to commencing installation of system.
3. Inspection of concrete anchors and thrust blocks.
4. Cold springing.
5. Hydrostatic test of all service lines.
6. Field joint closure work.
7. Air test of conduit.
8. Repair of any coatings.
9. Holiday test of conduit coating.
10. Installation of cathodic protection system.
11. Initial backfill up to 250 mm (10 inches) above the top of the casing.
12. The slope of the system. Elevation readings shall be witnessed and recorded.
13. Testing of cathodic protection system.
14. Operational tests.

D. Reports to Contracting Officer:

1. Obtain a written report prepared daily and signed by the representative of the system manufacturer. Present the original report to the RE/COTR on the same day it is prepared, and forward one copy to the manufacturer's main office.
2. The report shall 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 plans, specifications, and manufacturer's printed instructions and is satisfactory in all respects. When any work connected with the installation is unsatisfactory, the report shall state what corrective action has been taken or shall contain the system manufacturer's recommendations for

corrective action. The report shall identify any conditions that could result in an unsatisfactory installation, including such items as open conduit ends left in the trench overnight and improper manhole entries. The daily reports are to be reviewed, signed and sealed by the Professional Engineer responsible for the system design. Signed and sealed copies of the daily report 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 as specified.

3. Upon completion of the work and before final acceptance, deliver to the RE/COTR a notarized Certificate of Compliance signed by principal officers of both the manufacturing and the contracting firm, stating that the installation is satisfactory and in accordance with plans, specifications, and manufacturer's instructions.
  4. The manufacturer 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.
- E. Protect casing coating from damage during rigging, storage and installation. Protect casing and carrier pipe ends from water intrusion during rigging and installation. Protect casing coatings from ultraviolet light (sunlight).
- F. Defective Material: The Representative shall take prompt action to return to the factory all damaged or defective material and shall order prompt replacement of such material.
- G. Slope of Carrier Pipes: Maintain constant slope as shown or 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 elevations shown on the contract drawings. Slope shall be uniform within 0.1 percent. These measurements shall be recorded by the Contractor, included in the direct buried system manufacturer representative's daily report, and given to the RE/COTR prior to covering the top of the casing with backfill.
- H. Cathodic Protection: Provide cathodic protection for all steel casing systems and all buried exposed metal. Provide dielectric pipe flanges and unions and isolation devices at all points necessary. Provide test stations at grade on each section of the piping system. Isolation flanges and unions shall be rated for the carrier pipe service temperature and pressure.

- I. Cleaning of Piping: 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.
- J. Wet Insulation: 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.
- K. Vents and Drains on Ends of DDT Systems: At each casing termination (end plate) in buildings and manholes, plug the casing drain openings with brass plugs and extend one inch pipe size ASTM A53 galvanized vent pipes from the casing vents through the tops of the manholes or one foot above the conduit in buildings. Terminate the outside vents in 180-degree bends.
- L. Buried Utility Warning Tape: Install tape 300 mm (12 inches) below grade above the piping system.

### 3.9 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.

### 3.10 THERMAL INSULATION:

- A. For piping in pre-engineered direct-buried systems refer to Part 2 of this specification.
- B. Steam, condensate and drip return piping, other than in pre-engineered direct buried systems, shall be insulated as follows:
  - 1. Piping in concrete trenches and manholes shall be insulated with calcium silicate, fiberglass, or cellular glass pipe insulation, glass cloth or aluminum jacket.
  - 2. Exposed piping in buildings shall be insulated with calcium silicate, fiberglass, or cellular glass pipe insulation, all service jacket. Condensate return piping may be insulated with rigid cellular phenolic, all service jacket.
  - 3. Piping in manholes shall be insulated with calcium silicate or cellular glass pipe insulation, glass cloth or aluminum jacket.
  - 4. Minimum Insulation Thickness: Insulation thicknesses given in Table 5 and 6 are manufacturer's nominal thickness.

TABLE 5 Minimum Pipe Insulation Thickness mm (inches) For Steam 110 to 1724 kPa (16 to 250 psi) gage				
Nominal Pipe Diameter mm (inches)	MPT-PC MPT-PF	Delta	Thermo-12 Super Caltemp	Foamglas
25 (1)	50 (2)	63 (2 1/2)	100 (4)	110 (4 1/2)
40 (1 1/2)	50 (2)	63 (2 1/2)	100 (4)	110 (4 1/2)

TABLE 5 Minimum Pipe Insulation Thickness mm (inches) For Steam 110 to 1724 kPa (16 to 250 psi) gage				
Nominal Pipe Diameter mm (inches)	MPT-PC MPT-PF	Delta	Thermo-12 Super Caltemp	Foamglas
50 (2)	63 (2 1/2)	85 (3 1/2)	110 (4 1/2)	125 (5)
65 (2 1/2)	63 (2 1/2)	85 (3 1/2)	110 (4 1/2)	125 (5)
80 (3)	75 (3)	100 (4)	125 (5)	150 (6)
100 (4)	75 (3)	100 (4)	125 (5)	150 (6)
125 (5)	75 (3)	100 (4)	125 (5)	150 (6)
150 (6)	85 (3 1/2)	110 (4 1/2)	135 (5 1/2)	150 (6)
200 (8)	85 (3 1/2)	110 (4 1/2)	135 (5 1/2)	150 (6)

TABLE 6 Minimum Pipe Insulation Thickness mm, (inches) For Steam less than 110 kPa (16 psi) gage, Condensate Return				
Nominal Pipe Diameter mm (inches)	MPT-PC MPT-PF	Delta	Foamglas Thermo-12 Super Caltemp	Koolphen K
25 (1) and under	35 (1 1/2)	50 (2)	75 (3)	25 (1)
40 (1 1/2)	35 (1 1/2)	50 (2)	75 (3)	25 (1)
50 (2)	35 (1 1/2)	50 (2)	75 (3)	25 (1)
65 (2 1/2)	35 (1 1/2)	50 (2)	75 (3)	25 (1)
80 (3)	50 (2)	63 (2 1/2)	85 (3 1/2)	25 (1)
100 (4)	50 (2)	63 (2 1/2)	85 (3 1/2)	38 (1 1/2)
125 (5)	50 (2)	63 (2 1/2)	85 (3 1/2)	38 (1 1/2)
150 (6)	63 (2 1/2)	76 (3)	110 (4 1/2)	38 (1 1/2)
200 (8)	63 (2 1/2)	76 (3)	110 (4 1/2)	38 (1 1/2)

Insulation listed has passed a boiling test:

Delta is available from Rockwool Manufacturing Co., Leeds, AL.

Foamglass is available from Pittsburgh Corning Corp., Pittsburgh, PA.

MPT is available from Mineral Products of Texas, Houston, TX.

Thermo-12 and Super Caltemp are available from Johns-Manville, Denver, CO.

Koolphen is available from Belform Insulation, London, Ontario.

5. Parts Not Insulated:

Threaded valves

Steam traps

Check valves

Unions

Threaded strainers

Strainer basket removal cover and bolting

Dielectric flanges and unions

6. Installation:

- a. Complete all pressure tests before installing insulation.
- b. All insulation material shall be new, clean, dry and stored in a clean dry environment; jacketing materials shall 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 manufacturers 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. On calcium silicate, cellular glass and rigid cellular phenolic insulated piping systems, fittings shall be insulated with field or

factory-shaped sections of insulation, finished with specified insulating and finishing cements and covered with jacket or PVC premolded cover. On sizes 50 mm (two inches) and smaller it is permissible to apply insulating and finishing cements, and cover with jacket or PVC premolded cover.

- l. Fiberglass insulated piping systems fittings over 50 mm (two inch) size 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 50 mm (two inches) and under apply insulating and finishing cements and cover with PVC fitting jacket.
- m. 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.

### **3.11 BURIED UTILITY WARNING TAPE:**

Bury directly above direct-buried system approximately 300 mm (12 inches) below grade.

### **3.12 TESTS:**

- 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 RE/COTR.
- 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. Radiographic testing of carrier pipe welds: Refer to Article, WELDING, in Part 3 of this specification.
- E. 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 RE/COTR.
- F. Hydrostatic and Operational Tests of Carrier Piping: Steam and condensate carrier piping shall be tested hydrostatically before insulation is applied at field joints and shall be proved tight at a pressure 1-1/2 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 RE/COTR 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 RE/COTR 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 1 kPa (0.1 psi).
  5. Repeat tests when failures occur.
  6. After completion of satisfactory test, replace all elements that have been removed prior to testing.
- G. 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 100 kPa (15 psi) 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 1 kPa (0.1 psi).
  4. Each casing field joint shall be tested for leaks by means of soap solution or equivalent.
- H. NACE-accredited corrosion specialist shall test cathodic protection systems and demonstrate proper operation and protection in accordance with the recommendations and criteria in NACE RP0169 and in Section 26 42 00, CATHODIC PROTECTION.
- I. Deficiencies discovered shall be corrected at the Contractor's expense, to satisfaction of RE/COTR. Major deficiencies or failure to correct deficiencies, to the satisfaction of the RE/COTR, may be considered cause for rejecting the entire installation.

- - - END - - -