

**Replace Water Tank  
693-09-128  
At VA Medical Center  
Wilkes-Barre, Pennsylvania**



## **SPECIFICATIONS**

**Submitted To:**

**U.S. Department of Veterans Affairs  
Veterans Affairs Medical Center  
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**March 5, 2013**

**DEPARTMENT OF VETERANS AFFAIRS  
VHA MASTER SPECIFICATIONS**

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

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

SHEET No.	DRAWING No.	DRAWING TITLE
1	T-1	TITLE, SITE PLAN, VICINITY PLAN AND INDEX OF DRAWINGS
2	T-2	LOCATION PLAN, GENERAL NOTES AND PROJECT SEQUENCING NOTES
3	C-1	SITE PLAN (NEW TANK SITE)
4	C-2	DEMOLITION PLAN (EXISTING TANK AND SITE PIPING)
5	C-3	SITE DETAILS
6	C-4	RETAINING WALL SECTIONS AND DETAILS
7	C-5	SOIL EROSION AND SEDIMENTATION CONTROL DETAILS
8	PI-1	ELEVATED STORAGE TANK PROCESS AND INSTRUMENTATION SCHEMATIC
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10	PR-1	ELEVATED STORAGE TANK PROCESS DRAWINGS
11	PR-2	ELEVATED STORAGE TANK PROCESS DETAILS
12	E-1	ELECTRICAL NOTES, SYMBOLS, ABBREVIATIONS, PANEL, LIGHTING SCHEDULES AND SINGLE LINE DIAGRAM
13	E-2	ELECTRICAL DEMOLITION AND SITE PLANS
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15	E-4	ELECTRICAL DEMOLITION, LIGHTING PROTECTION AND GROUNDING PLANS
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**SECTION 01 00 00  
GENERAL REQUIREMENTS**

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

**1.1 GENERAL INTENTION**

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work to Replace Water Tank at the VA Medical Center in Wilkes-Barre, PA as required by drawings and specifications.
- B. Visits to the site by Bidders may be made only during the official pre-bid site visit.
- C. Offices of DCS Infrastructure and Hatch Mott MacDonald, Inc., as Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.
- D. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the Contracting Officer's Representative (COR) in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the COR.
- E. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.
- F. Prior to commencing work, general contractor shall provide proof that a OSHA certified "competent person" (CP) (29 CFR 1926.20(b)(2)) will maintain a presence at the work site whenever the general or subcontractors are present.
- G. Training:
  - 1. The designated superintendent of the general contractor shall have the 30-hour OSHA certified Construction Safety course and other relevant competency training, as determined by VA CP with input from the ICRA team. All employees of the general contractor or subcontractors shall have the 10-hour OSHA certified Construction

Safety course and other relevant competency training, as determined by VA CP with input from the ICRA team.

2. Submit training records of all such employees for approval before the start of work.

## 1.2 STATEMENT OF BID ITEM(S)

- A. ITEM 1, REPLACE WATER STORAGE TANK: Work includes general construction, alterations, roads, excavation (excluding rock excavation), grading, drainage, mechanical, electrical and instrumentation work; demolition of existing tank, piping and appurtenances; construction of new tank, tank foundation and all necessary piping and appurtenances; and all necessary testing and commissioning of new tank, piping and appurtenances.

B. ITEM 2 - ROCK EXCAVATION

The contractor shall furnish all labor and equipment to excavate and remove rock as classified and measured in accordance with the Section 31 20 00, Earth Moving. The amount of rock excavation is estimated at approximately 900 cubic yards.

The quantity of Rock Excavation, as classified in the specifications, has been estimated to be 900 cubic yards. If less than 900 cubic yards is removed, as measured in accordance with the specifications, the contract price will be reduced by the unit price times the difference. If more than 900 cubic yards is removed, as measured in accordance with the specifications, the contract price will be increased by the unit price times the difference. For example, if the measurement of rock removed is 1,000 cubic yards, the contract price will be increased by [1000-900] cubic yards times the unit price. If the measurement of rock removed is less than 900 cubic yards, the contract price will be reduced by the amount of 900 cubic yards, less the cubic yards measured, times the unit price.

C. UNIT PRICE REQUIREMENTS

(This unit price shall be used as a basis to compute payment to the contractor for work less than or in excess of 900 CY stipulated in the Total Bid.)

UNIT PRICE 1: UNIT PRICE FOR ROCK EXCAVATION \$ \_\_\_\_\_ per Cubic Yard

D. ITEM 3 - CONTAMINATED SOIL ABATEMENT

The contractor shall furnish all labor and equipment to excavate, store and dispose of contaminated soil as shown on the drawings and in accordance with Specification Section 31 20 01, Contaminated Soil



Abatement. The amount of contaminated soil to be removed is estimated at approximately 400 cubic yards. This unit price shall be used as a basis to compute payment to the contractor for work less than or in excess of 900 CY stipulated in the Total Bid.

UNIT PRICE 2: UNIT PRICE FOR SOIL ABATEMENT \$ \_\_\_\_\_ per Cubic Yard

E. All bid items are mandatory. The total of all items represents the total amount of the bid.

### **1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR**

- A. AFTER AWARD OF CONTRACT, no sets of specifications and drawings will be furnished.
- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense, from solicitation on FedBizOps.

### **1.4 CONSTRUCTION SECURITY REQUIREMENTS**

#### **A. Security Plan:**

- 1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
- 2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.

#### **B. Security Procedures:**

- 1. General Contractor's employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
- 2. For working outside the "regular hours" as defined in the contract, The General Contractor shall give 3 days notice to the Contracting Officer so that security arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.
- 3. No photography of VA premises is allowed without written permission of the Contracting Officer.

4. VA reserves the right to close down or shut down the project site and order General Contractor's employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the Contracting Officer.

C. Guards:

Not Applicable for this Project.

D. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the COR for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.
2. The General Contractor shall turn over all permanent lock cylinders to the VA locksmith for permanent installation. See Section 22 12 16, FACILITY ELEVATED, POTABLE-WATER STORAGE TANKS and coordinate.

E. Document Control:

1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of sensitive information.
2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
3. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of sensitive information.

**1.5 FIRE SAFETY**

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

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

E84-2008.....Surface Burning Characteristics of Building  
Materials

2. National Fire Protection Association (NFPA):

10-2006.....Standard for Portable Fire Extinguishers

30-2007.....Flammable and Combustible Liquids Code

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

70-2007.....National Electrical Code

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

3. Occupational Safety and Health Administration (OSHA):

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

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

- F. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to COR and facility Safety Officer.
- G. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- H. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- I. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with COR and facility Safety Officer. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the COR.
- J. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR. Obtain permits from facility Safety Officer at least 24 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- K. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR and facility Safety Officer.
- L. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- M. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- N. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

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

#### **1.6 OPERATIONS AND STORAGE AREAS**

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the 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 COR.
- E. Workmen are subject to rules of Medical Center applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not

permitted in buildings that are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by COR where required by limited working space.

1. Do not store materials and equipment in other than in construction assigned staging 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.

G. Phasing: To insure such executions, Contractor shall furnish the COR with a schedule of approximate phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. The phase schedule order cannot be changed. In addition, Contractor shall notify the COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof (does not apply to Notice to Proceed). Arrange such phasing dates to insure accomplishment of this work in successive phases mutually agreeable to COR and Contractor, as follows:

**Phase I:**

**Excavation, Construction of elevated water storage tank, retaining wall, and site piping.**

**Phase II:**

**Connection of site piping, commissioning and start-up of new elevated water storage tank, and site piping.**

**Phase III:**

**Decommissioning and demolition of existing water storage tank and valve chamber.**

H. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, seven feet minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at

maximum 15 inches. Bottom of fences shall extend to one inch above grade. Remove the fence when directed by COR.

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

1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the Medical Center Director's prior knowledge and written approval. Refer to specification Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS for additional requirements.
2. Contractor shall submit a request to interrupt any such services to COR, in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Medical Center. Interruption time approved by Medical Center may occur at other than Contractor's normal working hours.
4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR.
5. In case of a contract construction emergency, service will be interrupted on approval of COR. Such approval will be confirmed in writing as soon as practical.
6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam,

payment of such fee shall be the responsibility of the Government and not the Contractor.

- L. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.
- M. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:
  - 1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles.
  - 2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR.
- N. Coordinate the work for this contract with other construction operations as directed by COR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

#### **1.7 ALTERATIONS**

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both to the Contracting Officer. This report shall list:
  - 1. Shall note any discrepancies between drawings and existing conditions at site.
  - 2. Shall designate areas for working space, materials storage and routes of access which have been agreed upon by Contractor and COR.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the



contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).

C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas involved. They shall furnish a report on conditions then existing as compared with conditions of same as noted in first condition survey report:

1. Re-survey report shall also list any damage caused by Contractor despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.

D. Protection: Provide the following protective measures:

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

#### **1.8 INFECTION PREVENTION MEASURES**

A. Implement the requirements of VAMC's Infection Control Risk Assessment (ICRA) team. ICRA Group may monitor dust in the vicinity of the construction work and require the Contractor to take corrective action immediately if the safe levels are exceeded.

B. Establish and maintain a dust control program as part of the contractor's infection preventive measures in accordance with the guidelines provided by ICRA Group. Prior to start of work, prepare a plan detailing project-specific dust protection measures, including periodic status reports, and submit to COR for review for compliance

with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

1. All personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.

C. Medical center Infection Control personnel shall monitor for airborne disease (e.g. aspergillosis) as appropriate during construction. A baseline of conditions may be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality. In addition:

1. In case of any problem, the medical center, along with assistance from the contractor, shall conduct an environmental assessment to find and eliminate the source.

D. In general, following preventive measures shall be adopted during construction to keep down dust and prevent mold.

1. Dampen debris to keep down dust.
2. Do not perform dust producing tasks within occupied areas without the approval of the COR.
  - a. The contractor shall not haul debris through patient-care areas without prior approval of the COR and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.
  - b. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.

E. Final Cleanup:

1. Upon completion of project, or as work progresses, remove all construction debris from areas that have been part of the construction.

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

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

1. Reserved items which are to remain property of the Government are identified by attached tags as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by COR.
2. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center.

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

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

**(FAR 52.236-9)**

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

**1.11 RESTORATION**

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the COR. Existing work to be altered or extended and that is found to be

defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.

- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good or better condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

#### **1.12 PHYSICAL DATA**

- A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.
  - 1. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by Hatch Mott MacDonald and a geotechnical investigation by Midlantic Engineering.

**(FAR 52.236-4)**

- B. Subsurface conditions have been developed by core borings and test pits by Midlantic Engineering. Logs of subsurface exploration are shown diagrammatically on drawings.

- C. A copy of the soil report will be made available for inspection by bidders upon request to the COR at the VA Medical Center, 1111 East End Blvd. Wilkes-Barre, PA, and shall be considered part of the contract documents.
- D. Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine site of work and logs of borings; and, after investigation, decide for themselves character of materials and make their bids accordingly.

#### **1.13 PROFESSIONAL SURVEYING SERVICES**

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

#### **1.14 LAYOUT OF WORK**

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

**(FAR 52.236-17)**

- B. Establish and plainly mark center marking for the new water storage tank, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations are in accordance with lines and elevations shown on contract drawings.

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

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

#### **1.15 AS-BUILT DRAWINGS**

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

#### **1.16 USE OF ROADWAYS**

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

#### **1.17 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT**

- A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to compliance with the following provisions:



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

#### **1.18 TEMPORARY TOILETS**

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

#### **1.19 AVAILABILITY AND USE OF UTILITY SERVICES**

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.
- C. Contractor shall install meters at Contractor's expense and furnish the Medical Center a monthly record of the Contractor's usage of electricity as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials.
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
  - 1. Obtain electricity by connecting to the Medical Center electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices

providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.

F. Water (for Construction and Testing): Furnish temporary water service.

1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection. Water is available at no cost to the Contractor.
2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR's discretion) of use of water from Medical Center's system.

G. Steam: Furnish steam system for testing required in various sections of specifications.

1. Obtain steam for testing by connecting to the Medical Center steam distribution system. Steam is available at no cost to the Contractor.
2. Maintain connections, pipe, fittings and fixtures and conserve steam-use so none is wasted. Failure to stop leakage or other waste will be cause for revocation (at COR's discretion), of use of steam from the Medical Center's system.

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

## **1.20 TESTS**

- A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.
- B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the Contracting Officer. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.

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

#### **1.21 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 (1 hard copy & 2 electronic copies of entire book) for each separate piece of equipment shall be delivered to the COR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of

equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

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

#### **1.22 RELOCATED EQUIPMENT/ITEMS**

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated by symbol "R" or otherwise shown to be relocated by the Contractor.
- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the COR.
- C. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".
- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.

- E. 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.

### **1.23 CONSTRUCTION SIGN**

- A. Provide a Construction Sign where directed by the COR. All wood members shall be of framing lumber. Cover sign frame with 24 gage galvanized sheet steel nailed securely around edges and on all bearings. Provide three 4 inch by 4 inch posts (or equivalent round posts) set four feet into ground. Set bottom of sign level at three feet above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with two by four inch material as directed.
- B. Paint all surfaces of sign and posts two coats of white gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.
- C. Maintain sign and remove it when directed by the COR.
- D. Detail Drawing of construction sign showing required legend and other characteristics of sign is available from the VA web site.

### **1.24 SAFETY SIGN**

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

**1.25 HISTORIC PRESERVATION**

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

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

**PART 1- GENERAL**

**1.1 DESCRIPTION:**

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

**1.2 CONTRACTOR'S REPRESENTATIVE:**

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

**1.3 CONTRACTOR'S CONSULTANT:**

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



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

#### **1.4 COMPUTER PRODUCED SCHEDULES**

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

#### **1.5 THE COMPLETE PROJECT SCHEDULE SUBMITTAL**

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

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

- D. Within 30 calendar days after receipt of the complete project interim Project Schedule and the complete final Project Schedule, the Contracting Officer or his representative, will do one or both of the following:
  - 1. Notify the Contractor concerning his actions, opinions, and objections.
  - 2. A meeting with the Contractor at or near the job site for joint review, correction or adjustment of the proposed plan will be scheduled if required. Within 14 calendar days after the joint review, the Contractor shall revise and shall submit three blue line copies of the revised Project Schedule, three copies of the revised computer-produced activity/event ID schedule and a revised electronic file as specified by the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.
- E. The approved baseline schedule and the computer-produced schedule(s) generated there from shall constitute the approved baseline schedule until subsequently revised in accordance with the requirements of this section.
- F. The Complete Project Schedule shall contain approximately 5 work activities/events.

#### **1.6 WORK ACTIVITY/EVENT COST DATA**

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

#### **1.7 PROJECT SCHEDULE REQUIREMENTS**

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

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

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

**1.8 PAYMENT TO THE CONTRACTOR:**

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

**1.9 PAYMENT AND PROGRESS REPORTING**

- A. Monthly schedule update meetings will be held on dates mutually agreed to by the COTR and the Contractor. Contractor and their CPM consultant (if applicable) shall attend all monthly schedule update meetings. The Contractor shall accurately update the Project Schedule and all other data required and provide this information to the COTR three work days in advance of the schedule update meeting. Job progress will be reviewed to verify:
1. Actual start and/or finish dates for updated/completed activities/events.
  2. Remaining duration for each activity/event started, or scheduled to start, but not completed.
  3. Logic, time and cost data for change orders, and supplemental agreements that are to be incorporated into the Project Schedule.
  4. Changes in activity/event sequence and/or duration which have been made, pursuant to the provisions of following Article, ADJUSTMENT OF CONTRACT COMPLETION.
  5. Completion percentage for all completed and partially completed activities/events.
  6. Logic and duration revisions required by this section of the specifications.

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

slippage as well as ways to improve the project schedule status, when appropriate.

#### **1.10 RESPONSIBILITY FOR COMPLETION**

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

#### **1.11 CHANGES TO THE SCHEDULE**

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

any other previously contracted item, shall be furnished in writing to the Contracting Officer for approval.

- C. Contracting Officer's approval for the revised project schedule and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the VA representative.
- D. The cost of revisions to the project schedule resulting from contract changes will be included in the proposal for changes in work as specified in FAR 52.243 - 4 (Changes) and VAAR 852.236 - 88 (Changes - Supplemental), and will be based on the complexity of the revision or contract change, man hours expended in analyzing the change, and the total cost of the change.
- E. The cost of revisions to the Project Schedule not resulting from contract changes is the responsibility of the Contractor.

#### **1.12 ADJUSTMENT OF CONTRACT COMPLETION**

- A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, CPM data and supporting evidence as the COTR may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in this request. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer-produced calendar-dated schedule for the time period in question and all other relevant information.
- B. Actual delays in activities/events which, according to the computer-produced calendar-dated schedule, do not affect the extended and predicted contract completion dates shown by the critical path in the network, will not be the basis for a change to the contract completion date. The Contracting Officer will within a reasonable time after receipt of such justification and supporting evidence, review the facts and advise the Contractor in writing of the Contracting Officer's decision.
- C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under FAR 52.243 - 4 (Changes) and VAAR 852.236 - 88 (Changes - Supplemental). The Contractor shall include, as a part of each change order proposal, a sketch showing all CPM logic revisions,



duration (in work days) changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.

- D. All delays due to non-work activities/events such as RFI's, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month by month basis.

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

- 1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- 1-2. For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1-3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
  - A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
  - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
  - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1-4. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.
- 1-5. Submittals will be reviewed for compliance with contract requirements by Engineer, and action thereon will be taken by Contracting Officer's Representative (COR) on behalf of the Contracting Officer.
- 1-6. Upon receipt of submittals, 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 Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- 1-9. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
  - A. Submit samples required by Section 09 00 00, WATER STORAGE TANK PAINTING, in quadruplicate. Submit other samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
  - B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail and shall contain the list of items, name of Medical Center, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
    1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.
    2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Medical Center, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
    3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.

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

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

F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.

1. For each drawing required, submit one legible photographic paper or vellum reproducible.
  2. Reproducible shall be full size.
  3. Each drawing shall have marked thereon, proper descriptive title, including Medical Center location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
  4. A space 4-3/4 by 5 inches shall be reserved on each drawing to accommodate approval or disapproval stamp.
  5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
  6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
  7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Engineer under one cover.
- 1-10. Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

Department of Veterans Affairs  
Medical Center  
1111 East End Blvd.  
Wilkes-Barre, PA 18711

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

DCS Infrastructure, LLC  
5 Muellers Lane  
Yaphank, NY 11980

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**SECTION 01 42 19**  
**REFERENCE STANDARDS**

**PART 1 - GENERAL****1.1 DESCRIPTION**

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

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

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

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

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

DEPARTMENT OF VETERANS AFFAIRS  
Office of Construction & Facilities Management  
Facilities Quality Service (00CFM1A)  
811 Vermont Avenue, NW - Room 462  
Washington, DC 20420  
Telephone Numbers: (202) 461-8217 or (202) 461-8292  
Between 9:00 AM - 3:00 PM

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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**SECTION 01 45 29**  
**TESTING LABORATORY SERVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

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

**1.2 APPLICABLE PUBLICATIONS:**

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

C39/C39M-05.....Compressive Strength of Cylindrical Concrete  
Specimens  
C109/C109M-05.....Compressive Strength of Hydraulic Cement Mortars  
C138-07.....Unit Weight, Yield, and Air Content  
(Gravimetric) of Concrete  
C140-07.....Sampling and Testing Concrete Masonry Units and  
Related Units  
C143/C143M-05.....Slump of Hydraulic Cement Concrete  
C172-07.....Sampling Freshly Mixed Concrete  
C173-07.....Air Content of freshly Mixed Concrete by the  
Volumetric Method  
C330-05.....Lightweight Aggregates for Structural Concrete  
C567-05.....Density Structural Lightweight Concrete  
C780-07.....Pre-construction and Construction Evaluation of  
Mortars for Plain and Reinforced Unit Masonry  
C1019-08.....Sampling and Testing Grout  
C1064/C1064M-05.....Freshly Mixed Portland Cement Concrete  
C1077-06.....Laboratories Testing Concrete and Concrete  
Aggregates for Use in Construction and Criteria  
for Laboratory Evaluation  
C1314-07.....Compressive Strength of Masonry Prisms  
D698-07.....Laboratory Compaction Characteristics of Soil  
Using Standard Effort  
D1143-07.....Piles Under Static Axial Compressive Load  
D1188-07.....Bulk Specific Gravity and Density of Compacted  
Bituminous Mixtures Using Paraffin-Coated  
Specimens  
D1556-07.....Density and Unit Weight of Soil in Place by the  
Sand-Cone Method  
D1557-07.....Laboratory Compaction Characteristics of Soil  
Using Modified Effort  
D2166-06.....Unconfined Compressive Strength of Cohesive Soil  
D2167-94 (R2001).....Density and Unit Weight of Soil in Place by the  
Rubber Balloon Method  
D2216-05.....Laboratory Determination of Water (Moisture)  
Content of Soil and Rock by Mass  
D2922-05.....Density of soil and Soil-Aggregate in Place by  
Nuclear Methods (Shallow Depth)  
D2974-07.....Moisture, Ash, and Organic Matter of Peat and  
Other Organic Soils



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

E. American Welding Society (AWS):

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

**1.3 REQUIREMENTS:**

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

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.1 EARTHWORK:**

- A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:
1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
  2. Provide part time observation of fill placement and compaction and field density testing in tank foundation areas and provide part time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
  3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.
- B. Testing Compaction:
1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with AASHTO T99/T180 Method A ASTM D698 D1557 Method A ASTM D698 and/or ASTM D1557.
  2. Make field density tests in accordance with the primary testing method following ASTM D2922 AASHTO T238 wherever possible. Field density tests utilizing ASTM D1556 AASHTO T191, or ASTM D2167 shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the COR before the tests are conducted.
    - a. Building Slab Subgrade: At least one test of subgrade for every 2000 square feet of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 2000 square feet of overlaying building slab, but in no case fewer than three tests.

- b. Foundation Wall Backfill: One test per 100 feet of each layer of compacted fill but in no case fewer than two tests.
  - c. Pavement Subgrade: One test for each 400 square yards, but in no case fewer than two tests.
  - d. Curb, Gutter, and Sidewalk: One test for each 300 feet, but in no case fewer than two tests.
  - e. Trenches: One test at maximum 100 foot intervals per 4 foot of vertical lift and at changes in required density, but in no case fewer than two tests.
  - f. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to COR. In each compacted fill layer below wall footings, perform one field density test for every 100 feet of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.
- C. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.
- D. Testing Materials: Test suitability of on-site and off-site borrow as directed by COR.

### **3.2 FOUNDATION PILES:**

- A. Witness load test procedure for conformance with ASTM D1143 and interpret test data to verify geotechnical recommendations for pile capacity. Submit load test report in accordance with ASTM D1143.
- B. Review Contractor's equipment, methods, and procedures prior to starting any work on site. Provide continuous inspection of pile installation. Maintain a record of all pertinent phases of operation for submittal to COR.
- C. Auger-Placed Piles: Take and test samples of grout in accordance with ASTM C109 for conformance with specified strength requirements. Not less than six cubes shall be made for each day of casting. Test three cubes at 7 days and three at 28 days.
- D. Cast-in-Place Concrete Piles: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.
- E. Prestressed Concrete Piles:

1. Inspection at Plant: Inspect forms, placement of reinforcing steel and strands, placement and finishing of concrete, and tensioning of strands.
2. Concrete Testing: Test concrete including materials for concrete as required in Article, CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.
3. Test strand for conformance with ASTM A416/A416M and furnish report to COR.
4. Inspect piles to insure specification requirements for curing and finishes have been met.

### **3.3 FOUNDATION CAISSONS:**

- A. Concrete Testing: Test concrete including materials for concrete as required in Article, CONCRETE of this section, except make two test cylinders for each day's placement of concrete.
- B. Maintain a record of concrete used in each caisson. Compare records with calculated volumes.
- C. Inspect percussion hole in bottom of each caisson to determine that material is capable of supporting design load.
- D. Inspect sides and bottom of each caisson for compliance with contract documents.
- E. Submit a certified "Caisson Field Record" for each caisson, recording actual elevation at bottom of shaft; final center line location of top; variation of shaft from plumb; results of all tests performed; actual allowable bearing capacity of bottom; depth of socket into rock; levelness of bottom; seepage of water; still water level (if allowed to flood); variation of shaft (from dimensions shown); location and size of reinforcement, and evidence of seams, voids, or channels below the bottom. Verify the actual bearing capacity of the rock strata by the use of a calibrated penetrometer or other acceptable method.
- F. Caissons Bearing on Hardpan: Take undisturbed samples, suitable for tests required, from caisson bottom. Make auger probe to a depth of 8 feet below bottom and visually inspect and classify soil. Verify continuity of strata and thickness.
  1. Conduct the following test on each sample, and report results and evaluations to the COR:
    - a. Unconfined Compression Test (ASTM D2166).
    - b. Moisture Content (ASTM D2216).
    - c. Density.

### **3.4 LANDSCAPING:**

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

**3.5 ASPHALT CONCRETE PAVING:**

- A. Aggregate Base Course:
  - 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with AASHTO T180, Method D ASTM D1557, Method D
  - 2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with AASHTO T191 ASTM D1556 .
  - 3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.
- B. Asphalt Concrete:
  - 1. Aggregate: Sample and test aggregates in stock pile and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104) .
  - 2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.
  - 3. Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

**3.6 SITE WORK CONCRETE:**

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

**3.7 POST-TENSIONING OF CONCRETE:**

- A. Inspection Prior to Concreting: Inspect tendons, drape of tendons, and anchorage components for compliance prior to concreting.
- B. Concrete Testing: As required in Article, CONCRETE of this section except make three test cylinders representing each area to be tensioned and cylinders shall be cured in same manner as concrete they represent. Make compression test prior to determining minimum specified strength required for post-tensioning.
- C. Post-tensioning: Witness post-tensioning operation and record actual gauge pressures and elongations applied to each tendon.

D. Submit reports in quadruplicate of the following:

1. Inspection of placement and post-tensioning of all tendons.
2. Size, number, location, and drape of tendons.
3. Calculated elongations, based upon the length, modulus of elasticity, and cross-sectional area of the tendons used.
4. Actual field elongations. Check elongation of tendons within ranges established by manufacturer.
5. Calculated gauge pressure and jacking force applied to each tendon.
6. Actual gauge pressures and jacking force applied to each tendon.
7. Required concrete strength at time of jacking.
8. Actual concrete strength at time of jacking.
9. Do not cut or cover the tendon ends until the Contractor receives the COR's written approval of the post-tensioning records.

**3.8 CONCRETE:**

A. Batch Plant Inspection and Materials Testing:

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

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the

- Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 50 cubic yards or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by COR make three cylinders for each 100 cubic yards or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. COR may require additional cylinders to be molded and cured under job conditions.
  4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
  5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m<sup>3</sup> (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 100 cubic yards at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
  6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
  7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
  8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
  9. Verify that specified mixing has been accomplished.
  10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
    - a. When ambient air temperature falls below 40 degrees F, record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.

- b. When ambient air temperature rises above 85 degrees F, record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
- 11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
- 12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
- 13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
- 14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
- 15. Observe preparations for placement of concrete:
  - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
  - b. Inspect preparation of construction, expansion, and isolation joints.
- 16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
- 17. Observe concrete mixing:
  - a. Monitor and record amount of water added at project site.
  - b. Observe minimum and maximum mixing times.
- 18. Measure concrete flatwork for levelness and flatness as follows:
  - a. Perform Floor Tolerance Measurements  $F_F$  and  $F_L$  in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
  - b. Perform all floortolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
  - c. Provide the Contractor and the COR with the results of all profile tests, including a running tabulation of the overall  $F_F$  and  $F_L$  values for all slabs installed to date, within 72 hours after each slab installation.
- 19. Other inspections:
  - a. Grouting under base plates.
  - b. Grouting anchor bolts and reinforcing steel in hardened concrete.
- C. Laboratory Tests of Field Samples:
  - 1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one



cylinder at 28 days. Use remaining cylinder as a spare tested as directed by COR. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.

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

### **3.9 REINFORCEMENT:**

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

### **3.10 SHOTCRETE:**

- A. Inspection and Material Testing:
  1. Provide field inspection and testing service as required by COR to certify that shotcrete has been applied in accordance with contract documents.
  2. Periodically inspect and test proportioning equipment for accuracy and report deficiencies to COR.

3. Sample and test mix ingredients as necessary to insure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Report instances of excessive moisture to COR.
5. Certify, in duplicate, that ingredients and proportions and amounts of ingredients in shotcrete conform to approved trial mixes.
6. Provide field inspection of the proper size and placement of the reinforcement in the shotcrete.

B. Shotcrete Sampling:

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

C. Laboratory Tests of Field Sample Panels:

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

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

**3.11 PRESTRESSED CONCRETE:**

- A. Inspection at Plant: Forms, placement and concrete cover of reinforcing steel and tendons, placement and finishing of concrete, and tensioning of tendons.

- B. Concrete Testing: Test concrete including materials for concrete required in Article, CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.
- C. Test tendons for conformance with ASTM A416 and furnish report to COR.
- D. Inspect members to insure that specification requirements for curing and finishes have been met.

**3.12 ARCHITECTURAL PRECAST CONCRETE:**

- A. Inspection at Plant: Forms, placement of reinforcing steel, concrete cover, and placement and finishing of concrete.
- B. Concrete Testing: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.
- C. Inspect members to insure specification requirements for curing and finishes have been met.

**3.13 MASONRY:**

- A. Mortar Tests:
  - 1. Laboratory compressive strength test:
    - a. Comply with ASTM C780.
    - b. Obtain samples during or immediately after discharge from batch mixer.
    - c. Furnish molds with 2 inch, 3 compartment gang cube.
    - d. Test one sample at 7 days and 2 samples at 28 days.
  - 2. Two tests during first week of operation; one test per week after initial test until masonry completion.
- B. Grout Tests:
  - 1. Laboratory compressive strength test:
    - a. Comply with ASTM C1019.
    - b. Test one sample at 7 days and 2 samples at 28 days.
    - c. Perform test for each 2500 square feet of masonry.
- C. Masonry Unit Tests:
  - 1. Laboratory Compressive Strength Test:
    - a. Comply with ASTM C140.
    - b. Test 3 samples for each 5000 square feet of wall area.
- D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 5000 square feet of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

**3.14 STRUCTURAL STEEL:**

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.
- B. Prefabrication Inspection:
  - 1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
  - 2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
  - 3. Approve welder qualifications by certification or retesting.
  - 4. Approve procedure for control of distortion and shrinkage stresses.
  - 5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.
- C. Fabrication and Erection:
  - 1. Weld Inspection:
    - a. Inspect welding equipment for capacity, maintenance and working condition.
    - b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
    - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
    - d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
    - e. Measure 25 percent of fillet welds.
    - f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
      - 1) 20 percent of all shear plate fillet welds at random, final pass only.
      - 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
      - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
      - 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
      - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
    - g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and

moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.

- h. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.
  - i. Verify that correction of rejected welds are made in accordance with AWS D1.1.
  - j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:
- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
  - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
  - c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
  - d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
  - e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
  - f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to COR.

### **3.15 STEEL DECKING:**

- A. Provide field inspection of welds of metal deck to the supporting steel, and testing services to insure steel decking has been installed in accordance with contract documents and manufacturer's requirements.
- B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS

D1.1. Refer to the "Plug Weld Qualification Procedure" in Part 3 "Field Quality Control."

- C. Submit inspection reports, certification, and instances of noncompliance to COR.

**3.16 SHEAR CONNECTOR STUDS:**

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

**3.17 SPRAYED-ON FIREPROOFING:**

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

**3.18 TYPE OF TEST:**

For number of tests required, see ASTM Standard Specifications, or Tank Manufacturer recommendations, whichever testing criteria is more stringent.

	Approximate Number of Tests Required
A. Earthwork:	
Laboratory Compaction Test, Soils:	
(AASHTO T180) (AASHTO T99) (ASTM D1557)/(ASTM D698)	
Field Density, Soils (AASHTO T191, T205, or T238)	_____
Penetration Test, Soils	_____
B. Landscaping:	
Topsoil Test	_____
C. Aggregate Base:	
Laboratory Compaction, (AASHTO T180) (ASTM D1557)	_____
Field Density, (AASHTO T191) (ASTM D1556)	_____
Aggregate, Base Course	
Gradation (AASHTO T27)	_____
Wear (AASHTO T96)	_____
Soundness (AASHTO T104)	_____
D. Asphalt Concrete:	
Field Density, (AASHTO T230) ASTM D1188	_____
Aggregate, Asphalt Concrete	
Gradation (AASHTO T27)	_____
Wear (AASHTO T96)	_____
Soundness (AASHTO T104)	_____
E. Concrete:	
Making and Curing Concrete Test Cylinders (ASTM C31)	_____
Compressive Strength, Test Cylinders (ASTM C39)	_____
Concrete Slump Test (ASTM C143)	_____
Concrete Air Content Test (ASTM C173)	_____

Gradation (ASTM C33) \_\_\_\_\_  
Deleterious Substances (ASTM C33) \_\_\_\_\_  
Soundness (ASTM C33) \_\_\_\_\_  
Abrasion (ASTM C33) \_\_\_\_\_

Aggregate, Lightweight

Gradation (ASTM C330) \_\_\_\_\_  
Deleterious Substances (ASTM C330) \_\_\_\_\_  
Unit Weight (ASTM C330) \_\_\_\_\_  
Flatness and Levelness Readings (ASTM E1155) (number of days) \_\_\_\_\_

F. Reinforcing Steel:

Tensile Test (ASTM A370) \_\_\_\_\_  
Bend Test (ASTM A370) \_\_\_\_\_  
Mechanical Splice (ASTM A370) \_\_\_\_\_  
Welded Splice Test (ASTM A370) \_\_\_\_\_

I. Masonry:

Making and Curing Test Cubes (ASTM C109) \_\_\_\_\_  
Compressive Strength, Test Cubes (ASTM C109) \_\_\_\_\_  
Sampling and Testing Mortar, Comp. Strength (ASTM C780) \_\_\_\_\_  
Sampling and Testing Grout, Comp. Strength (ASTM C1019) \_\_\_\_\_  
Masonry Unit, Compressive Strength (ASTM C140) \_\_\_\_\_  
Prism Tests (ASTM C1314) \_\_\_\_\_

J. Structural Steel:

Ultrasonic Testing of Welds (ASTM E164) \_\_\_\_\_  
Magnetic Particle Testing of Welds (ASTM E709) \_\_\_\_\_  
Radiographic Testing of Welds (ASTM E94) \_\_\_\_\_

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

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

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

7. Sanitary Wastes:

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

**1.2 QUALITY CONTROL**

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

**1.3 REFERENCES**

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

**1.4 SUBMITTALS**

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

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

#### **1.5 PROTECTION OF ENVIRONMENTAL RESOURCES**

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

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

7. Manage and control spoil areas on Government property to limit spoil to areas shown on the Environmental Protection Plan and prevent erosion of soil or sediment from entering nearby water courses or lakes.
  8. Protect adjacent areas from despoilment by temporary excavations and embankments.
  9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
  10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
  11. Handle discarded materials other than those included in the solid waste category as directed by the COR.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
  2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
  3. Monitor water areas affected by construction.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list species that require specific attention along with measures for their protection.
- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Pennsylvania Department of Environmental

Protection and Federal emission and performance laws and standards and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.

1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
  2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
  3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
  4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
1. Perform construction activities involving repetitive, high-level impact noise only between 8:00 a.m. and 6:00 p.m. unless otherwise permitted by local ordinance or the COR. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75
  2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:
    - a. Maintain maximum permissible construction equipment noise levels at 50 feet (dBA):

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

- b. Use shields or other physical barriers to restrict noise transmission.
  - c. Provide soundproof housings or enclosures for noise-producing machinery.
  - d. Use efficient silencers on equipment air intakes.
  - e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
  - f. Line hoppers and storage bins with sound deadening material.
  - g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 65 dB(A) noise level. Measure noise exposure at the property line or 50 feet from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at three to six feet in front of any building face. Submit the recorded information to the COR noting any problems and the alternatives for mitigating actions.
- G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.

H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the COR. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

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

**1.2 RELATED WORK**

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

C. Lead Paint: Section 02 83 33.13, LEAD BASED PAINT REMOVAL AND DISPOSAL.

### **1.3 QUALITY ASSURANCE**

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

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

#### **1.4 TERMINOLOGY**

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

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

#### **1.5 SUBMITTALS**

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

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

#### **1.6 APPLICABLE PUBLICATIONS**

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

#### **1.7 RECORDS**

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

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

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

## **PART 3 - EXECUTION**

### **3.1 COLLECTION**

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

### **3.2 DISPOSAL**

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

### **3.3 REPORT**

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

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**SECTION 02 21 00**  
**SITE SURVEYS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

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

**1.2 DEFINITIONS**

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

**PART 2 - EXECUTION**

- A. The surveyor shall research available public records for all mapping, monumentation, plats, governmental surveys etc. that may pertain to the subject property. Research all applicable public utilities for substructure data such as sewers, storm drains, water lines, electrical conduits etc.
- B. The survey shall be performed on the ground in accordance with the current "Accuracy Standards for Land Title Surveys" as adopted, from time to time, by the American Congress on Surveying and Mapping, the National Society of Professional Surveyors, and the American Land Title Association.
- C. The surveyor, when applicable, shall consult with the project Engineer to determine scale of plat or map and size of drawings.
- D. The surveyor shall furnish two sets of prints of the plat or map of survey and an electronic CADD file. If the plat or map of survey consists of more than one sheet, the sheets shall be numbered, the total number of sheets indicated and the match lines be shown on each sheet.
- E. On the plat or map, the survey boundary shall be drawn to a convenient scale, or the scale designated by the Engineer, with the scale clearly indicated. A graphic scale, shown in feet or meters or both, shall be included. A north arrow shall be shown and when practicable, the plat or map of survey shall be oriented so that north is at the top of the drawing. Symbols or abbreviations used shall be identified on the face of the plat or map by use of a legend or other means. Supplementary or exaggerated diagrams shall be presented accurately on the plat or map



where dimensional data is too small to be shown clearly at full scale.  
The plat or map shall be 30 by 42 inches.

F. The survey shall contain the following applicable information:

1. The name, address, telephone number, and signature of the Professional Land Surveyor who made the survey, his or her official seal and registration number, the date the survey was completed and the dates of all revisions.
2. The survey drawing(s) submitted shall bear the following certification adjacent to the Engineer's official seal:  
"I hereby certify that all information indicated on this drawing was obtained or verified by actual measurements in the field and that every effort has been made to furnish complete and accurate information."
3. Vicinity map showing the property surveyed in reference to nearby highways or major street intersections.
4. Flood zone designation (with proper annotation based on Federal Flood Insurance Rate Maps or the state or local equivalent, by scaled map location and graphic plotting only).
5. Land area as defined by the boundaries of the legal description of the surveyed premises.
6. All data necessary to indicate the mathematical dimensions and relationships of the boundary represented by bearings and distances, and the length and radius of each curve, together with elements necessary to mathematically define each curve. The point of beginning of the surveyor's description and the basis of bearings shall also be shown.
7. When record bearings or angles or distances differ from measured bearings, angles or distances, both record and measured bearings, angles, and distances shall be clearly indicated. If the record description fails to form a mathematically closed figure, the surveyor shall so indicate.
8. Measured and record distances from corners of parcels surveyed to the nearest right-of-way lines of streets in urban or suburban areas, together with recovered lot corners and evidence of lot corners, shall be noted. The distances to the nearest intersecting street shall be indicated and verified. Names and widths of streets and highways abutting the property surveyed and widths of rights of way shall be given. Observable evidence of access (or lack thereof) to such abutting streets or highways shall be indicated. Observable evidence of private roads shall be so indicated. Streets abutting the

- premises, which have been described in Record Documents, but not physically opened, shall be shown and so noted.
9. The identifying titles of all recorded plats, filed maps, right of way maps, or similar documents which the survey represents, wholly or in part, with their appropriate recording data. The survey shall indicate platted setback or building restriction lines which have been recorded in subdivision plats or which appear in a Record Document which has been delivered to the surveyor. Contiguity, gores, and overlaps along the exterior boundaries of the survey premises, where ascertainable from field evidence or Record Documents, or interior to those exterior boundaries, shall be clearly indicated or noted. Where only a part of a recorded lot or parcel is included in the survey, the balance of the lot or parcel shall be indicated.
  10. All evidence of found monuments shall be shown and noted. All evidence of monuments found beyond the surveyed premises on which establishment of the corners of the survey premises are dependent, and their application related to the survey shall be indicated.
  11. The character of any and all evidence of possession shall be stated and the location of such evidence carefully given in relation to both the measured boundary lines and those established by the record. An absence of notation on the survey shall be presumptive of no observable evidence of possession. The term "possession" does not imply "ownership".
  12. The location of all buildings upon the plot or parcel shall be shown and their locations defined by measurements perpendicular to the boundaries. If there are no buildings, so state. Proper street numbers shall be shown where available.
  13. All easements evidenced by a Record Document which have been delivered to the surveyor shall be shown, both those burdening and those benefiting the property surveyed, indicating recording information. If such an easement cannot be located, a note to this affect shall be included. Observable evidence of easements and/or servitudes of all kinds, such as those created by roads, rights-of-ways, water courses, drains, telephone, telegraph, or electric lines, water, sewer, oil or gas pipelines on or across the surveyed property and on adjoining properties if they appear to affect the surveyed property, shall be located and noted. Surface indications, if any, or of underground easements and/or servitudes shall also be shown.
  14. The character and location of all walls, buildings, fences, and other visible improvements within five feet of each side of the boundary lines shall be noted. Without expressing a legal opinion, physical

- evidence of all encroaching structural appurtenances and projections, such as fire escapes, bay windows, windows and doors that open out, flue pipes, stoops, eaves, cornices, areaways, stoops, trip, etc., by or on adjoining property or on abutting streets, on any easement or over setback lines shown by Record Documents shall be indicated with the extent of such encroachment or projection.
15. Driveways and alleys on or crossing the property must be shown. Where there is evidence of use by other than the occupants of the property, the surveyor must so indicate on the plat or map. Where driveways or alleys on adjoining properties encroach, in whole or in part, on the property being surveyed, the surveyor must so indicate on the plat or map with appropriate measurements.
  16. Location, alignment and dimensions of all roads, curbs, walks, parking and paved areas abutting the subject land. Indicate road centerlines with true bearings and lengths by 50 foot stationing. Describe curves by designating the points of curvature and tangency by station. Include all curve data as well a location of radius and vertex points. Elevations on 50' centers on centerline of roads, edges of roads and top and bottom of curbs.
  17. As accurately as the evidence permits, the location of cemeteries and burial grounds disclosed in the process of researching title to the premises or observed in the process of performing the field work for the survey, shall be shown.
  18. Ponds, lakes, springs, or rivers bordering on or running through the premises being surveyed shall be shown. When a property surveyed contains a natural water boundary, the surveyor shall measure the location of the boundary according to appropriate surveying methods and note on the plat or map the date of the measurement and the caveat that the boundary is subject to change due to natural causes and that it may or may not represent the actual location of the limit of title. When the surveyor is aware of changes in such boundaries, the extent of those changes shall be identified.
  19. Contours at a minimum interval of 1 foot. Base vertical control on the permanent (not assumed) National Geodetic Survey (NGS) or VA Medical Center Bench Mark. Note location, description and datum.
  20. Identify and show if possible, setback, height, and floor space area restrictions of record or disclosed by applicable zoning or building codes (in addition to those recorded in subdivision maps). If none, so state.

21. Exterior dimensions of all buildings at ground level. Show square footage of exterior footprint of all buildings at ground level and gross floor area of all buildings.
22. Measured height of all buildings above grade at a defined location. If no defined location is provided, the point of measurement shall be shown.
23. Elevations at each entrance to buildings, service docks, building corners, steps, ramps and grade slabs.
24. Substantial, visible improvements (in addition to buildings) such as signs, parking areas, swimming pools, etc.
25. Parking areas and, if striped, the striping and the type (eg. handicapped, motorcycle, regular, etc.) and number of parking spaces.
26. Indication of access to a public way such as curb cuts and driveways.
27. Location of utilities existing on or serving the surveyed property as determined by observed evidence together with plans and markings provided by utility companies, and other appropriate sources (with references as to the source of information. Locate and show all fire hydrants located within 500 feet of the subject property.
28. Railroad tracks and sidings.
29. Manholes, catch basins, valve vaults or other surface indications of subterranean uses.
30. Wires and cables (including their function) crossing the survey premises, all poles on or within ten feet of the surveyed premises, and the dimensions of all cross-wires or overhangs affecting the surveyed premises.
31. Utility company installations on the surveyed premises.
32. Names of adjoining owners of platted lands.
33. Observable evidence of earth moving work, building construction or building additions within recent months.
34. Any changes in street right-of-way lines either completed or proposed, and available from the controlling jurisdiction. Observable evidence of recent street or sidewalk construction or repairs.
35. Observable evidence of site use as a solid waste dump, sump or sanitary landfill.
36. All trees with a minimum diameter of 6" measured at 48" above the base of the tree. Perimeter outline only of thickly wooded areas with description of predominant vegetation.

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**SECTION 02 41 00**  
**DEMOLITION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

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

**1.2 RELATED WORK:**

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING
- B. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Lead Paint: Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
- F. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- G. Construction Waste Management: Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT.
- H. Contaminated Soil Abatement: Section 31 20 01, CONTAMINATED SOIL ABATEMENT.
- I. Asbestos Cement Pipe Removal: Section 02 82 13.32, ASBESTOS CEMENT PIPE ABATEMENT.

**1.3 PROTECTION:**

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.

- D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.
- E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.
- F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
  - 1. No wall or part of wall shall be permitted to fall outwardly from structures.
  - 2. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
  - 3. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 15 feet of fire hydrants.
- G. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center; any damaged items shall be repaired or replaced as approved by the Contracting Officer's Representative (COR). The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COR's approval.
- H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- I. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.

#### **1.4 UTILITY SERVICES:**

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

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

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.1 GENERAL DEMOLITION REQUIREMENTS:**

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

3.2 DEMOLITION OF WATER STORAGE TANK, FOUNDATION AND APPURTENANCES:

The Contractor shall completely remove the existing steel water storage tank, piping, and electrical appurtenances at the VA Medical Facility as shown on the Project Plans.

The Contractor shall inspect the existing steel tank to determine the full extent of demolition required, size of the tank, and the condition of the existing tank. The tank will be removed from service following successful commissioning of the new water storage tank.

The interior and exterior tank coatings, as well as the surrounding soil near the existing tank have been determined to contain lead. The Contractor shall refer to all lead testing results provided in the Bid Documents, and shall have no claim for additional costs for unforeseen existing conditions.

The Contractor is solely responsible for the removal of any and all sludge and debris that may be existing within the tank. In addition, the Contractor shall remove from the project site all other debris resulting from their operations. All material removed from the tank shall be removed by an approved method. The Contractor shall comply with all local, state and federal regulations regarding the disposal of solid and hazardous wastes. The Contractor shall advise himself of all applicable regulations and shall undertake the necessary testing in order to comply with said regulations. The Contractor shall pay for all costs associated with testing, permits and disposal of solid and hazardous wastes generated as a result of the project.

It is the intent that the steel tank be removed in sections and that existing coatings will not be disturbed during demolition. However, the Contractor shall be wholly responsible for disposal of existing paint coatings and residues removed, for providing containment as necessary for collection, storage, transportation, disposal and permitting procedures, and shall conduct such in accordance with USEPA, PADEP, Pennsylvania Department of Health, OSHA, Department of Veteran Affairs and all applicable Federal, State and local regulations. Work shall be in conformance with the Steel Structures Painting Removal Guides SSPCD-Guide 61 (CON), latest edition. The Contractor shall be responsible for obtaining and complying with the contents of these Guides.

The removal and disposal of the tank shall be conducted by the Contractor in accordance with all applicable requirements of the Pennsylvania Department of Labor and Industry. In addition, all Contractors must be certified in accordance with the requirements of Pennsylvania Act 44 of 1995, and OSHA 29 C.F.R. Chapter 62, Standards for Lead Certification, as applicable.



In addition to observing limitations of the Owner's property, the Contractor shall confine apparatus, storage of materials, and construction operations to the limits prescribed by ordinances of permits, or as may be directed by the Owner, and shall not encumber the job site.

The Contractor agrees to conform to, comply with, and abide by, any and all laws, ordinances, rules and regulations of the federal government, state or local government which pertain to or in any way affect the work to be done by the Contractor, any and all instructions and regulations of the Owner pertaining thereto, including any laws, ordinances, rules, regulations and instructions regarding signs, advertising, fire and/or smoking.

The Contractor shall comply with all notice requirements of all regulating agencies and notify such agencies at least twenty-four (24) hours prior to starting the demolition work or such longer periods as may be required by such agencies. The Contractor must pay all inspecting costs and fees required by such agencies. The Contractor must notify such agencies and their inspectors whenever work will not be performed by the Contractor and the Contractor will be responsible for any additional inspection fees or costs incurred because of his failure to give adequate notice.

The Contractor is especially directed to and shall comply with all local state and federal regulations regarding the disposal of solid waste. The Contractor shall advise himself of all applicable regulations and shall undertake the necessary testing in order to comply with said regulations.

The Contractor shall furnish upon request by the Owner, the results of the waste classification testing. The Contractor shall be fully responsible for the costs of all testing, permits and disposal of solid waste generated as a result of this project.

THE USE OF EXPLOSIVES WILL NOT BE PERMITTED.

The Contractor is to provide adequate protection of other work during his operations to prevent damage or detrimental effects which may arise from general exposure, adverse weather, adjacent construction operations, or activities at the work location.

The Contractor is to clean all adjacent structures and improvements of dust, dirt and debris caused by his demolition operations.

The Contractor is to promptly repair all damage caused to adjacent existing or new facilities by demolition operations at no cost to the Owner. All adjacent areas and existing facilities are to be restored to at least the condition existing prior to the start of the work unless the Contract Documents indicate otherwise.

The Contractor is to remove from the site all debris, rubbish, and other materials resulting from his demolition work. Burning of demolished and/or removed materials shall not be permitted on this site.

The Contractor is to conduct demolition work and the disposal of debris in such a manner so as to ensure a minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. He is not to obstruct occupied or used facilities.

### 3.02 PROTECTION OF STRUCTURES AND PROPERTY

The Contractor shall execute demolition work so that adjacent property is protected against damages which might occur from falling debris or other cause. The Contractor shall not interfere with the use of adjacent building(s) and shall maintain free and safe passage to and from same.

The Contractor shall take all precautions to guard against the movement, settlement or collapse of any sidewalks or street passages of adjoining property and shall be liable for any movement, settlement or collapse and shall repair promptly such damage.

The Contractor shall repair all damage done to Owner's property or any other person, or persons on or off premises by reason of required work.

### 3.03 DEBRIS

The Contractor shall remove all debris resulting from the demolition.

The Contractor shall not store, or permit debris to accumulate on the site. If the Contractor fails to remove excess debris after more than 48 hours and after written notification by the Government to the Contractor for said removal, the Government reserves the right to cause the same to be removed at the Contractor's expense. Costs incurred by the Government shall be deducted from the payments to be made to the Contractor.

### **3.3 CLEAN-UP:**

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COR. Clean-up shall include off the Medical Center disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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**SECTION 02 82 13.32  
ASBESTOS CEMENT PIPE REMOVAL**

**TABLE OF CONTENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY OF THE WORK**

**1.1.1 CONTRACT DOCUMENTS AND RELATED REQUIREMENTS**

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

**1.1.2 EXTENT OF WORK**

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

50 linear feet of 8-inch diameter asbestos cement pipe.

**1.2 DEFINITIONS**

ACM - Nonfriable is classified as either Category I ACM or Category II ACM. Category I ACM and Category II ACM are distinguished from each other by their potential to release fibers when damaged.

Category I nonfriable ACM means asbestos-containing packings, gaskets, resilient floor covering, and asphalt roofing products containing more than 1 percent asbestos as determined using the method specified in appendix E, subpart E, 40 CFR part 763, section 1, Polarized Light Microscopy.

Category II nonfriable ACM means any material, excluding Category I nonfriable ACM, for example, asbestos-cement (A/C) pipe, A/C shingles and transite boards or panels, containing more than 1 percent asbestos as determined using the methods specified in appendix E, subpart E, 40 CFR part 763, section 1, Polarized Light Microscopy that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Amended water means water to which a surfactant has been added.

Containment Work Area is the area that has been isolated by the use of plastic on horizontal and vertical surfaces and equipped with an air differential pressure filtration device and air lock chamber for entry and egress.

Limited Containment Enclosure is an enclosure built out of one layer of polyethylene sheeting around the material to be removed. The Contractor shall use 2 x 4 wood as needed as no walls are present to hang the wall and ceiling polyethylene.

Grinding means to reduce to powder or small fragments and includes mechanical chipping or drilling.

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

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

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

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

Poor condition means the binding of the material is losing its integrity as indicated by peeling, cracking, or crumbling of the material.

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

### **1.3 APPLICABLE CODES AND REGULATIONS**

#### **1.3.1 GENERAL APPLICABILITY OF CODES, REGULATIONS, AND STANDARDS**

- A. All work under this contract shall be done in strict accordance with all applicable Federal, State, and local regulations, standards and codes governing asbestos, and any other trade work done in conjunction with the abatement. All applicable codes,

regulations and standards are adopted into this specification and will have the same force and effect as this specification.

- B. The most recent edition of any relevant regulation, standard, document or code shall be in effect. Where conflict among the requirements or with these specifications exists, the most stringent requirement(s) shall be utilized.

### **1.3.2 CONTRACTOR RESPONSIBILITY**

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

### **1.3.3 FEDERAL REQUIREMENTS**

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

- A. Occupational Safety and Health Administration (OSHA)
  - 1. Title 29 CFR 1926.1101 - Construction Standard for Asbestos
  - 2. Title 29 CFR 1910 Subpart I - Personal Protective Equipment
  - 3. Title 29 CFR 1910.134 - Respiratory Protection
  - 4. Title 29 CFR 1926 - Construction Industry Standards
  - 5. Title 29 CFR 1910.1020 - Access to Employee Exposure and Medical Records
  - 6. Title 29 CFR 1910.1020 - Hazard Communication
  - 7. Title 29 CFR 1910 Subpart K - Medical and First Aid
- B. Environmental Protection Agency (EPA)
  - 1. 40 CFR 61 Subpart A and M (Revised Subpart B) - National Emission Standard for Hazardous Air Pollutants - Asbestos.
  - 2. 40 CFR 763.80 - Asbestos Hazard Emergency Response Act (AHERA)
- C. Department of Transportation (DOT)
  - Title 49 CFR 100 - 185 - Transportation

### **1.4 PRE-CONSTRUCTION MEETING**

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

- A. Proof the Competent Person(s) is trained and accredited and approved for working in this State. Verification of the experience of the Competent Person(s) shall also be presented.

- B. A list of all workers who will participate in the project, including experience and verification of training and accreditation.
- C. A list of and verification of training for all personnel who have current first-aid/CPR training. A minimum of one person per shift must have adequate training.
- D. Current medical written opinions for all personnel working on-site meeting the requirements of 29 CFR 1926.1101 (m).
- E. Current fit-tests for all personnel wearing respirators on-site meeting the requirements of 29 CFR 1926.1101 (h) and Appendix C.
- F. A copy of the Contractor's Removal Plan. In these procedures, the following information must be detailed, specific for this project.
  - 1. Regulated area preparation procedures;
  - 2. Notification requirements procedure of Contractor as required in 29 CFR 1926.1101 (d);
  - 3. Decontamination area set-up/layout and decontamination procedures for employees;
  - 4. removal methods/procedures and equipment to be used; and
  - 5. Personal protective equipment to be used.
- G. At this meeting the Contractor shall provide all submittals as required.
- H. Procedures for handling, packaging and disposal of asbestos waste.
- I. Emergency Action Plan and Contingency Plan Procedures.

#### **1.5 PROJECT COORDINATION**

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

##### **1.5.1 PERSONNEL**

- A. Administrative and supervisory personnel shall consist of a qualified Competent Person(s) as defined by OSHA in the Construction Standards and the Asbestos Construction Standard; Contractor Professional Industrial Hygienist and Industrial Hygiene Technicians. These employees are the Contractor's representatives responsible for compliance with these specifications and all other applicable requirements.
- B. Non-supervisory personnel shall consist of an adequate number of qualified personnel to meet the schedule requirements of the project. Personnel shall meet required qualifications. Personnel utilized on-site shall be pre-approved by the VA representative. A request for approval shall be submitted for any person to be employed during the project giving the person's name; social security number; qualifications; accreditation card with color picture; Certificate of Worker's Acknowledgment; and Affidavit of Medical Surveillance and Respiratory Protection and current Respirator Fit Test.
- C. The Personnel performing the asbestos cement pipe cutting and removal shall have completed the EPA AHERA/OSHA Operation and Maintenance/Class III training course; have training on the standard operating procedures of the Contractor; has one year of asbestos experience within the past three (3) years of similar size and complexity; has applicable medical and respiratory protection documentation; has certificate of training/current refresher. All personnel should be in compliance with OSHA

construction safety training as applicable and submit certification.

## **PART 2 - PRODUCTS, MATERIALS AND EQUIPMENT**

### **2.1 MATERIALS AND EQUIPMENT**

#### **2.1.1 GENERAL REQUIREMENTS (ALL ABATEMENT PROJECTS)**

Prior to the start of work, the contractor shall provide and maintain a sufficient quantity of materials and equipment to assure continuous and efficient work throughout the duration of the project. Work shall not start unless the following items have been delivered to the site.

- A. All materials shall be delivered in their original package, container or bundle bearing the name of the manufacturer and the brand name (where applicable).
- B. Store all materials subject to damage off the ground, away from wet or damp surfaces and under cover sufficient enough to prevent damage or contamination. Flammable and combustible materials cannot be stored inside buildings.
- C. The Contractor shall not block or hinder use of buildings by patients, staff, and visitors to the VA in partially occupied buildings by placing materials/equipment in any unauthorized location.
- D. The Competent Person shall inspect for damaged, deteriorating or previously used materials. Such materials shall not be used and shall be removed from the worksite and disposed of properly.
- E. Polyethylene sheeting for the regulated area shall be a minimum of 6-mils. Fire retardant poly shall be used throughout.
- F. An adequate number of HEPA vacuums, rags, staple guns, water hose to reach all areas in the regulated area, and any other tools, materials or equipment required to conduct the project. All electrically operated hand tools, equipment, electric cords shall be connected to GFCI protection.
- G. Disposal bags - Materials shall be wrapped in 2 layers of 6 mil poly for asbestos cement waste and shall be pre-printed with labels, markings and address as required by OSHA, EPA and DOT regulations or appropriate labels shall be affixed to the outer layer of the final container.
- H. The VA shall be provided an advance copy of the MSDS as required for all hazardous chemicals under OSHA 29 CFR 1910.1200 - Hazard Communication in the pre-project submittal. Chlorinated compounds shall not be used with any spray adhesive, mastic remover or other product. Appropriate encapsulant(s) shall be provided.
- I. OSHA DANGER demarcation signs, as many and as required by OSHA 29 CFR 1926.1101(k)(7) shall be provided and placed by the Competent Person. All other posters and notices required by Federal and State regulations shall be posted.
- N. Adequate and appropriate PPE for the project and number of personnel/shifts shall be provided. All personal protective equipment issued must be based on a written hazard assessment conducted under 29 CFR 1910.132(d).

## **2.2 CONTAINMENT BARRIERS AND COVERINGS IN THE REGULATED AREA**

### **2.2.1 GENERAL**

- A. Completely separate any operations in the regulated area from adjacent areas using 1 layer of 6-mil fire retardant poly.
- B. Secure the entire work area with caution tape.

## **PART 3 - EXECUTION**

### **3.1 REGULATED AREA PREPARATIONS**

#### **3.1.1 SITE SECURITY**

Regulated area access is to be restricted only to authorized, trained/accredited and protected personnel. These may include the Contractor's employees, employees of Subcontractors, VA employees and representatives, State and local inspectors, and any other designated individuals.

#### **3.1.2 OSHA DANGER SIGNS**

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

#### **3.1.3 NEGATIVE PRESSURE FILTRATION SYSTEM**

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

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

#### **3.1.4 CONTAINMENT BARRIERS AND COVERINGS FOR THE REGULATED AREA**

##### **3.1.4.1 GENERAL**

- A. Using polyethylene sheets, seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent areas. All surfaces in the regulated area must be covered to prevent contamination and to facilitate clean-up.



### **3.2 REMOVAL OF ASBESTOS CEMENT PIPE MATERIALS**

#### **3.2.1 OUTDOOR WORK AREAS**

If outdoor work is to be performed, all applicable OSHA, state and local regulations must be followed to ensure that outdoor work areas are in compliance so that workers, the general public and the environment are protected.

#### **3.2.2 EXCAVATION/TRENCHING WORK AREA PROTECTION**

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

#### **3.2.3 REMOVAL OF ASBESTOS CEMENT PIPE**

##### **3.2.3.1 EXECUTION:**

The Contractor shall adhere to the following procedures.

- A. Establish and maintain a facility for showering and changing clothes shall be available at the abatement location so that workers can shower after performing asbestos related Work. The shower shall be of sufficient size, equipped with hot and cold water, soap, and towels so that personnel can properly shower. At a minimum, all workers shall shower at the end of each shift.
- B. The Asbestos Abatement Contractor shall coordinate with the General Contractor, if different) for the excavation of the underground pipe. Special care shall be taken to not damage the pipe insulation during excavation.
- C. All workers shall wear respirators and protective clothing.
- D. Discharge no visible emissions to the air during the collection, processing, packaging, or transporting of any asbestos-containing (waste) material generated.
- E. Prior to removal, the Contractor shall spray asbestos materials with Amended Water. The asbestos materials shall be sufficiently saturated (as possible) without causing excessive dripping to prevent emission of airborne fibers. Asbestos containing materials shall be sprayed repeatedly during the Work Process to maintain a wet condition. If the materials are not easily saturated, then the Work Area shall be constantly misted to keep fiber emission minimal.

- F. The Contractor shall remove asbestos in manageable sections by a multiperson team. ACM shall not be allowed to dry out. The pipe will not be cut or broken.
- G. If the pipe is in poor condition or cutting or breaking is required, any cutting or breaking shall be performed utilizing a glovebag technique.
- H. The section of pipe shall be wrapped in two layers of polyethylene sheets with each layer separately sealed. Label or wrapped materials in accordance with 40 CFR 61 Subpart M.
- I. The asbestos waste must be placed in an approved waste container appropriately marked according to regulations.
- J. Copies of Bill of Lading or waste manifests shall be provided to the Engineer.

### **3.3 DISPOSAL OF WASTE MATERIAL**

#### **3.3.1 GENERAL**

The VA must be notified in advance of any waste removed disposal. Dispose of waste ACM and debris which is packaged in accordance with these specifications, OSHA, EPA and DOT. The landfill requirements for packaging must also be met. Transport will be in compliance with 49 CFR 100-185 regulations. Disposal shall be done at an approved landfill. Disposal of non-friable ACM shall be done in accordance with applicable regulations.

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**SECTION 02 83 33.13**  
**LEAD-BASED PAINT REMOVAL AND DISPOSAL**

**RT 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies abatement and disposal of lead-based paint (LBP) and controls needed to limit occupational and environmental exposure to lead hazards.

**1.2 RELATED WORK**

- A. Section 02 82 13.32, ASBESTOS CEMENT PIPE ABATEMENT.
- B. Section 02 41 00, DEMOLITION.

**1.3 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. Code of Federal Regulations (CFR):
  - CFR 29 Part 1910.....Occupational Safety and Health Standards
  - CFR 29 Part 1926.....Safety and Health Regulations for Construction
  - CFR 40 Part 148.....Hazardous Waste Injection Restrictions
  - CFR 40 Part 260.....Hazardous Waste Management System: General
  - CFR 40 Part 261.....Identification and Listing of Hazardous Waste
  - CFR 40 Part 262.....Standards Applicable to Generators of Hazardous Waste
  - CFR 40 Part 263.....Standards Applicable to Transporters of Hazardous Waste
  - CFR 40 Part 264.....Standards for Governments and Operations of Hazardous Waste Treatment, Storage, and Disposal Facilities
  - CFR 40 Part 265.....Interim Status Standards for Governments and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
  - CFR 40 Part 268.....Land Disposal Restrictions
  - CFR 49 Part 172.....Hazardous Material Table, Special Provisions, Hazardous Material Communications, Emergency Response Information, and Training Requirements
  - CFR 49 Part 178.....Specifications for Packaging
- C. National Fire Protection Association (NFPA):
  - NFPA 701-2004.....Methods of Fire Test for Flame-Resistant Textiles and Films
- D. National Institute for Occupational Safety And Health (NIOSH)
  - NIOSH OSHA Booklet 3142.           Lead in Construction

E. Underwriters Laboratories (UL)

UL 586-1996 (Rev 2009).. High-Efficiency, Particulate, Air Filter  
Units

F. American National Standards Institute

Z9.2-2006.....Fundamentals Governing the Design and Operation  
of Local Exhaust Systems

Z88.6-2006.....Respiratory Protection

**1.4 DEFINITIONS**

- A. Action Level: Employee exposure, without regard to use of respirations, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8-hour period. As used in this section, "30 micrograms per cubic meter of air" refers to the action level.
- B. Area Monitoring: Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations which may reach the breathing zone of personnel potentially exposed to lead.
- C. Physical Boundary: Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area."
- D. Certified Industrial Hygienist (CIH): As used in this section, refers to an Industrial Hygienist employed by the Contractor and is certified by the American Board of Industrial Hygiene in comprehensive practice.
- E. Change Rooms and Shower Facilities: Rooms within the designated physical boundary around the lead control area equipped with separate storage facilities for clean protective work clothing and equipment and for street clothes which prevent cross- contamination.
- F. Competent Person: A person capable of identifying lead hazards in the work area and is authorized by the contractor to take corrective action.
- G. Decontamination Room: Room for removal of contaminated personal protective equipment (PPE).
- H. Eight-Hour Time Weighted Average (TWA): Airborne concentration of lead averaged over an 8-hour workday to which an employee is exposed.
- I. High Efficiency Particulate Air (HEPA) Filter Equipment: HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron size particles.
- J. Lead: Metallic lead, inorganic lead compounds, and organic lead soaps. Excluded from this definition are other organic lead compounds.

- K. Lead Control Area: An enclosed area or structure with full containment to prevent the spread of lead dust, paint chips, or debris of lead-containing paint removal operations. The lead control area is isolated by physical boundaries to prevent unauthorized entry of personnel.
- L. Lead Permissible Exposure Limit (PEL): Fifty micrograms per cubic meter of air as an 8-hour time weighted average as determined by 29 CFR 1910.1025. If an employee is exposed for more than 8 hours in a work day, the PEL shall be determined by the following formula. 
$$\text{PEL (micrograms/cubic meter of air)} = 400/\text{No. of hrs worked per day}$$
- M. Personnel Monitoring: Sampling of lead concentrations within the breathing zone of an employee to determine the 8-hour time weighted average concentration in accordance with 29 CFR 1910.1025. Samples shall be representative of the employee's work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 150 mm to 225 mm (6 to 9 inches) and the center at the nose or mouth of an employee.

#### **1.5 QUALITY ASSURANCE**

- A. Before exposure to lead-contaminated dust, provide workers with a comprehensive medical examination as required by 29 CFR 1926.62 (I) (1) (i) & (ii). The examination shall not be required if adequate records show that employees have been examined as required by 29 CFR 1926.62(I) without the last year.
- B. Medical Records: Maintain complete and accurate medical records of employees in accordance with 29 CFR 1910.20.
- C. CIH Responsibilities: The Contractor shall employ a certified Industrial Hygienist who will be responsible for the following:
  - 1. Certify Training.
  - 2. Review and approve lead-containing paint removal plan for conformance to the applicable referenced standards.
  - 3. Inspect lead-containing paint removal work for conformance with the approved plan.
  - 4. Direct monitoring.
  - 5. Ensure work is performed in strict accordance with specifications at all times.
  - 6. Ensure hazardous exposure to personnel and to the environment are adequately controlled at all times.
- D. Training: Train each employee performing paint removal, disposal, and air sampling operations prior to the time of initial job assignment, in accordance with 29 CFR 1926.62.
- E. Training Certification: Submit certificates signed and dated by the CIH and by each employee stating that the employee has received training.

F. Respiratory Protection Program:

1. Furnish each employee required to wear a negative pressure respirator or other appropriate type with a respirator fit test at the time of initial fitting and at least every 6 months thereafter as required by 29 CFR 1926.62.
2. Establish and implement a respiratory protection program as required by 29 CFR 1910.134, 29 CFR 1910.1025, and 29 CFR 1926.62.

G. Hazard Communication Program: Establish and implement a Hazard Communication Program as required by 29 CFR 1910.1200.

H. Hazardous Waste Management: The Hazardous Waste Management plan shall comply with applicable requirements of Federal, State, and local hazardous waste regulations and address:

1. Identification of hazardous wastes associated with the work.
2. Estimated quantities of wastes to be generated and disposed of.
3. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact. Furnish two copies of EPA Identification numbers.
4. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.
5. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.
6. Spill prevention, containment, and cleanup contingency measures to be implemented.
7. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily.
8. Cost for hazardous waste disposal according to this plan.

I. Safety and Health Compliance:

1. In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, state, and local authorities regarding removing, handling, storing, transporting, and disposing of lead waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1910.1025. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work.
2. Where specification requirements and the referenced documents vary, the most stringent requirements shall apply.

J. Pre-Construction Conference: Along with the CIH, meet with the Contracting Officer to discuss in detail the lead-containing paint removal work plan, including work procedures and precautions for the work plan.

## 1.6 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Catalog Data:
  - Vacuum filters
  - Respirators
- C. Instructions: Paint removal materials. Include applicable material safety data sheets.
- D. Statements Certifications and Statements:
  - 1. Qualifications of CIH: Submit name, address, and telephone number of the CIH selected to perform responsibilities in paragraph entitled "CIH Responsibilities." Provide previous experience of the CIH. Submit proper documentation that the Industrial Hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification.
  - 2. Testing Laboratory: Submit the name, address, and telephone number of the testing laboratory selected to perform the monitoring, testing, and reporting of airborne concentrations of lead. Provide proper documentation that persons performing the analysis have been judged proficient by successful participation within the last year in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) Program. The laboratory shall be accredited by the American Industrial Hygiene Association (AIHA). Provide AIHA documentation along with date of accreditation/reaccreditation.
  - 3. Lead-Containing Paint Removal Plan:
    - a. Submit a detailed job-specific plan of the work procedures to be used in the removal of lead-containing paint. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination rooms, change rooms, shower facilities, and mechanical ventilation system.
    - b. Include in the plan, eating, drinking, smoking and restroom procedures, interface of trades, sequencing of lead related work, collected wastewater and paint debris disposal plan, air sampling plan, respirators, protective equipment, and a detailed description of the method of containment of the operation to ensure that airborne lead concentrations of 30 micrograms per cubic meter of air are not exceeded outside of the lead control area.

- c. Include air sampling, training and strategy, sampling methodology, frequency, duration of sampling, and qualifications of air monitoring personnel in the air sampling portion on the plan.
- 4. Field Test Reports: Monitoring Results: Submit monitoring results to the Contracting Officer within 3 working days, signed by the testing laboratory employee performing the air monitoring, the employee that analyzed the sample, and the CIH.
- 5. Records:
  - a. Completed and signed hazardous waste manifest from treatment or disposal facility.
  - b. Certification of Medical Examinations.
  - c. Employee training certification.

## **PART 2 PRODUCTS**

PAINT REMOVAL PRODUCTS: Submit applicable Material Safety Data Sheets for paint removal products used in paint removal work. Use the least toxic product, suitable for the job and acceptable to the Industrial Hygienist.

## **PART 3 EXECUTION**

### **3.1 PROTECTION**

- A. Notification: Notify the Contracting Officer 20 days prior to the start of any paint removal work.
- B. Lead Control Area Requirements.
  - 1. Establish a lead control area by completely enclosing with containment screens the area or structure where lead-containing paint removal operations will be performed.
  - 2. Contain removal operations by the use of a negative pressure full containment system with at least one change room and with HEPA filtered exhaust.
- C. Protection of Existing Work to Remain: Perform paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition.
- D. Boundary Requirements: Provide physical boundaries around the lead control area by roping off the area [designated on the drawings] or providing curtains, portable partitions or other enclosures to ensure that airborne concentrations of lead will not reach 30 micrograms per cubic meter of air outside of the lead control area.
- E. Heating, Ventilating and Air Conditioning (HVAC) Systems: Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6-mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area.



- F. Change Room and Shower Facilities: Provide clean change rooms and shower facilities within the physical boundary around the designated lead control area in accordance with requirements of 29 CFR 1926.62.
- G. Mechanical Ventilation System:
  - 1. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.57.
  - 2. To the extent feasible, use fixed local exhaust ventilation connected to HEPA filters or other collection systems, approved by the industrial hygienist. Local exhaust ventilation systems shall be designed, constructed, installed, and maintained in accordance with ANSI Z9.2.
  - 3. If air from exhaust ventilation is recirculated into the work place, the system shall have a high efficiency filter with reliable back-up filter and controls to monitor the concentration of lead in the return air and to bypass the recirculation system automatically if it fails. Air may be recirculated only where exhaust to the outside is not feasible.
- H. Personnel Protection: Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been given appropriate training and protective equipment.
- I. Warning Signs: Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

### **3.2 WORK PROCEDURES**

- A. Perform removal of lead-containing paint in accordance with approved lead-containing paint removal plan. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-containing paint is removed in accordance with 29 CFR 1926.62, except as specified herein. Dispose of removed paint chips and associated waste in compliance with Environmental Protection Agency (EPA), federal, state, and local requirements.
- B. Personnel Exiting Procedures:
  - 1. Whenever personnel exist the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:
    - a. Vacuum themselves off.
    - b. Remove protective clothing in the decontamination room, and place them in an approved impermeable disposal bag.

- c. Shower.
  - d. Change to clean clothes prior to leaving the physical boundary designated around the lead-contaminated job site.
- C. Monitoring: Monitoring of airborne concentrations of lead shall be in accordance with 29 CFR 1910.1025 and as specified herein. Air monitoring, testing, and reporting shall be performed by a CIH or an Industrial Hygiene (IH) Technician who is under the direction of the CIH:
- 1. The CIH or the IH Technician under the direction of the CIH shall be on the job site directing the monitoring, and inspecting the lead-containing paint removal work to ensure that the requirements of the Contract have been satisfied during the entire lead-containing paint removal operation.
  - 2. Take personal air monitoring samples on employees who are anticipated to have the greatest risk of exposure as determined by the CIH. In addition, take air monitoring samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.
  - 3. Submit results of air monitoring samples, signed by the CIH, within 72 hours after the air samples are taken. Notify the Contracting Officer immediately of exposure to lead at or in excess of the action level of 30 micrograms per cubic meter of air outside of the lead control area.
- D. Monitoring During Paint Removal Work:
- 1. Perform personal and area monitoring during the entire paint removal operation. Sufficient area monitoring shall be conducted at the physical boundary to ensure unprotected personnel are not exposed above 30 micrograms per cubic meter of air at all times. If the outside boundary lead levels are at or exceed 30 micrograms per cubic meter of air, work shall be stopped and the CIH shall immediately correct the condition(s) causing the increased levels and notify the Contracting Officer immediately.
  - 2. The CIH shall review the sampling data collected on that day to determine if condition(s) requires any further change in work methods. Removal work shall resume when approval is given by the CIH. The Contractor shall control the lead level outside of the work boundary to less than 30 micrograms per cubic meter of air at all times. As a minimum, conduct area monitoring daily on each shift in which lead paint removal operations are performed in areas immediately adjacent to the lead control area.

3. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area. If adjacent areas are contaminated, clean and visually inspect contaminated areas. The CIH shall certify that the area has been cleaned of lead contamination.

### **3.3 LEAD-CONTAINING PAINT REMOVAL**

- A. Remove paint within the areas designated on the drawings in order to completely expose the substrate. Take whatever precautions are necessary to minimize damage to the underlying substrate.
- B. Indoor Lead Paint Removal: Select paint removal processes to minimize contamination of work areas with lead-contaminated dust or other lead-contaminated debris/waste. This paint removal process should be described in the lead-containing paint removal plan. Perform manual sanding and scraping to the maximum extent feasible.
- C. Mechanical Paint Removal and Blast Cleaning: Perform mechanical paint removal and blast cleaning in lead control areas using negative pressure full containments with HEPA filtered exhaust. Collect paint residue and spent grit (used abrasive) from blasting operations for disposal in accordance with EPA, state and local requirements.
- D. Outside Lead Paint Removal: Select removal processes to minimize contamination of work areas with lead-contaminated dust or other lead-contaminated debris/waste. This paint removal process should be described in the lead-containing paint removal plan. Perform manual sanding and scraping to the maximum extent feasible.

### **3.4 SURFACE PREPARATIONS**

Avoid flash rusting or other deterioration of the substrate. Provide surface preparations for painting.

### **3.5 CLEANUP AND DISPOSAL**

- A. Cleanup: Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner and wet mopping the area.
- B. Certification: The CIH shall certify in writing that the inside and outside the lead control area air monitoring samples are less than 30 micrograms per cubic meter of air, the respiratory protection for the employees was adequate, the work procedures were performed in accordance

with 29 CFR 1926.62, and that there were no visible accumulations of lead-contaminated paint and dust on the worksite. Do not remove the lead control area or roped-off boundary and warning signs prior to the Contracting Officer's receipt of the CIH's certification. Reclean areas showing dust or residual paint chips.

C. Testing of Lead-Containing Paint Residue and Used Abrasive Where indicated or when directed by the Contracting Officer, test lead containing paint residue and used abrasive in accordance with 40 CFR 261 for hazardous waste.

D. Disposal:

1. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing, which may produce airborne concentrations of lead particles.
2. Store removed paint, lead-contaminated clothing and equipment, and lead-contaminated dust and cleaning debris into U.S. Department of Transportation (49 CFR 178) approved 55-gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date lead-contaminated wastes were first put into the drum. Obtain and complete the Uniform Hazardous Waste Manifest forms from [Activity Staff Civil Engineer located. Comply with land disposal restriction notification requirements as required by 40 CFR 268:
  - a. At least 14 days prior to delivery, notify the Contracting Officer who will arrange for job site inspection of the drums and manifests by [PWC Hazardous Waste Storage Facility personnel
  - b. As necessary, make lot deliveries of hazardous wastes to the PWC Hazardous Waste Storage Facility to ensure that drums do not remain on the jobsite longer than 90 calendar days from the date affixed to each drum.
- a. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing which may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62. Dispose of lead-contaminated waste material at EPA approved hazardous waste treatment, storage, or disposal facility off Government property.
- b. Store waste materials in U.S. Department of Transportation (49 CFR 178) approved 55-gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. The Contracting Officer or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.

- c. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.
- E. Disposal Documentation Submit written evidence that the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA and state or local regulatory agencies. Submit one copy of the completed manifest, signed and dated by the initial transporter in accordance with 40 CFR 262.

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**SECTION 03 30 53**  
**(SHORT-FORM) CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

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

**1.2 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

**1.3 TOLERANCES:**

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

**1.4 REGULATORY REQUIREMENTS:**

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

**1.5 SUBMITTALS:**

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

**1.6 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
  - 117R-10.....Tolerances for Concrete Construction and Materials
  - 211.1-91(R2009).....Proportions for Normal, Heavyweight, and Mass Concrete
  - 211.2-98(R2004).....Proportions for Structural Lightweight Concrete
  - 301-11.....Specification for Structural Concrete
  - 305R-10.....Hot Weather Concreting
  - 306R-10.....Cold Weather Concreting

SP-66-04 .....ACI Detailing Manual  
318/318R-11.....Building Code Requirements for Reinforced  
Concrete  
347R-08.....Guide to Formwork for Concrete  
C. American Society for Testing And Materials (ASTM):  
A185-07.....Steel Welded Wire, Fabric, Plain for Concrete  
Reinforcement  
A615/A615M-09.....Deformed and Plain Billet-Steel Bars for  
Concrete Reinforcement  
A996/A996M-09.....Standard Specification for Rail-Steel and Axle-  
Steel Deformed Bars for Concrete Reinforcement  
C31/C31M-10.....Making and Curing Concrete Test Specimens in  
the Field  
C33-11.....Concrete Aggregates  
C39/C39M-10.....Compressive Strength of Cylindrical Concrete  
Specimens  
C94/C94M-10.....Ready-Mixed Concrete  
C143/C143M-10.....Standard Test Method for Slump of Hydraulic  
Cement Concrete  
C150-09.....Portland Cement  
C171-07.....Sheet Material for Curing Concrete  
C172-10.....Sampling Freshly Mixed Concrete  
C173-10.Air Content of Freshly Mixed Concrete by the Volumetric Method  
C192/C192M-07.....Making and Curing Concrete Test Specimens in  
the Laboratory  
C231-10.....Air Content of Freshly Mixed Concrete by the  
Pressure Method  
C260-10.....Air-Entraining Admixtures for Concrete  
C330-09.....Lightweight Aggregates for Structural Concrete  
C494/C494M-10.....Chemical Admixtures for Concrete  
C618-08.....Coal Fly Ash and Raw or Calcined Natural  
Pozzolan for Use in Concrete  
D1751-08.....Preformed Expansion Joint Fillers for Concrete  
Paving and Structural Construction (Non-  
extruding and Resilient Bituminous Types)  
D4397-10.....Polyethylene Sheeting for Construction,  
Industrial and Agricultural Applications

E1155-96(2008).....Determining  $F_F$  Floor Flatness and  $F_L$  Floor  
Levelness Numbers

## **PART 2 - PRODUCTS**

### **2.1 FORMS:**

Wood, plywood, metal, or other materials, approved by Contracting Officer's Representative (COR), of grade or type suitable to obtain type of finish specified.

### **2.2 MATERIALS:**

- A. Portland Cement: ASTM C150, Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 12 inches thick. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.
- D. Fine Aggregate: ASTM C33.
- E. Lightweight Aggregate for Structural Concrete: ASTM C330, Table 1
- F. Mixing Water: Fresh, clean, and potable.
- G. Air-Entraining Admixture: ASTM C260.
- H. Chemical Admixtures: ASTM C494.
- I. Vapor Barrier: ASTM D4397, 10 mil.
- J. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See structural drawings for grade.
- K. Welded Wire Fabric: ASTM A185.
- L. Expansion Joint Filler: ASTM D1751.
- M. Sheet Materials for Curing Concrete: ASTM C171.
- N. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- O. Liquid Hardener and Dustproofer: Fluosilicate solution or magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer.
- P. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- Q. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout shall show no settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement, and produce a



compressive strength of at least 2500 psi at 3 days and 5000 psi at 28 days.

### 2.3 CONCRETE MIXES:

- A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days shall be not less than 4500 psi.
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 4 inches tested in accordance with ASTM C143.
- E. Cement and water factor (See Table I):

**TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE**

Concrete: Strength	Non-Air-Entrained		Air-Entrained	
Min. 28 Day Comp. Str. psi	Min. Cement lbs/c. yd	Max. Water Cement Ratio	Min. Cement lbs/c. yd	Max. Water Cement Ratio
5000 <sup>1,3</sup>	630	0.45	650	0.40
4000 <sup>1,3</sup>	550	0.55	570	0.50
3000 <sup>1,3</sup>	470	0.65	490	0.55
3000 <sup>1,2</sup>	500	*	520	*

- 1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 1200 psi in excess of f'c. For concrete strengths above 5000 psi, the proposed mix design shall achieve a compressive strength 1400 psi in excess of f'c.

- 2. Lightweight Structural Concrete. Pump mixes may require higher cement values.

- 3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.

\* Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

- F. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS. Air content shall conform with the following tables :

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

Nominal Maximum Size of Coarse Aggregate	Total Air Content Percentage by Volume
3/8 in	6 to 10
1/2 in	5 to 9
3/4 in	4 to 8
1 in	3 1/2 to 6 1/2
1 1/2 in	3 to 6

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

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

#### **2.4 BATCHING & MIXING:**

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

#### **PART 3 - EXECUTION**

##### **3.1 FORMWORK:**

- A. Installation conforms to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.

- B. Treating and Wetting: Treat or wet contact forms as follows:
1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
  2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather cool metal forms by thoroughly wetting with water just before placing concrete.
  3. Use sealer on reused plywood forms as specified for new material.
- C. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.
- D. Construction Tolerances:
1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
  2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

### **3.2 REINFORCEMENT:**

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

### **3.3 VAPOR BARRIER:**

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

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

### **3.4 PLACING CONCRETE:**

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

### **3.5 PROTECTION AND CURING:**

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

### **3.6 FORM REMOVAL:**

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

### **3.7 SURFACE PREPARATION:**

Immediately after forms have been removed and work has been examined and approved by COR, remove loose materials, and patch all stone

pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part Portland cement and 2 to 3 parts sand.

### **3.8 FINISHES:**

#### **A. Vertical and Overhead Surface Finishes:**

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

#### **B. Slab Finishes:**

1. Scratch Finish: Slab surfaces to receive a bonded applied cementitious application shall all be thoroughly raked or wire broomed after partial setting (within 2 hours after placing) to roughen surface to insure a permanent bond between base slab and applied cementitious materials.

2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.
3. Float Finish: Ramps, stair treads, and platforms, both interior and exterior, equipment pads, and slabs to receive non-cementitious materials, except as specified, shall be screened and floated to a smooth dense finish. After first floating, while surface is still soft, surfaces shall be checked for alignment using a straightedge or template. Correct high spots by cutting down with a trowel or similar tool and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat the slab to a uniform sandy texture.
4. Steel Trowel Finish: Applied toppings, concrete surfaces to receive resilient floor covering or carpet, future floor roof and all monolithic concrete floor slabs exposed in finished work and for which no other finish is shown or specified shall be steel troweled. Final steel troweling to secure a smooth, dense surface shall be delayed as long as possible, generally when the surface can no longer be dented with finger. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure on trowel to compact cement paste and form a dense, smooth surface. Finished surface shall be free of trowel marks, uniform in texture and appearance.
5. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.
6. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:

Slab on grade & Shored suspended slabs	Unshored suspended slabs
Specified overall value $F_F$ 25/ $F_L$ 20	Specified overall value $F_F$ 25
Minimum local value $F_F$ 17/ $F_L$ 15	Minimum local value $F_F$ 17

### 3.9 SURFACE TREATMENTS:

- A. Surface treatments shall be mixed and applied in accordance with manufacturer's printed instructions.

- B. Liquid Densifier/Sealer: Use on all exposed concrete floors and concrete floors to receive carpeting except those specified to receive non-slip finish .
- C. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of all concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Aggregate shall be broadcast uniformly over concrete surface. Trowel concrete surface to smooth dense finish. After curing, rub the treated surface with abrasive brick and water sufficiently to slightly expose abrasive aggregate.

**3.10 APPLIED TOPPING:**

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

**3.11 RESURFACING FLOORS:**

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

**3.12 RETAINING WALLS:**

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

**3.13 PRECAST CONCRETE ITEMS:**

Precast concrete items, not specified elsewhere, shall be cast using 5000 psi air-entrained concrete to shapes and dimensions shown. Finish surfaces to match corresponding adjacent concrete surfaces. Reinforce with steel as necessary for safe handling and erection.

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**SECTION 04 00 00**  
**RETAINING WALL SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Work includes furnishing and installing precast modular blocks (PMB) to the lines and grades shown on the plans and as specified herein. Also included is furnishing and installing appurtenant materials required for construction of the complete system.
- B. The contractor is solely responsible for safety. The Engineer and Government shall not be responsible for means or methods of construction or for safety of workers or the public.

**1.2 References**

- A. ASTM - American Society for Testing and Materials (AASHTO - American Association of State and Highway Transportation Officials)
- B. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens (AASHTO T22)
- C. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate (AASHTO T27)
- D. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (AASHTO T89 & T90)
- E. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (AASHTO T99)
- F. ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- G. ASTM D4595 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
- H. ASTM D5262 - Standard Test Method for Evaluating the Unconfined Creep Behavior of Geosynthetics
- I. ASTM D6638 - Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)
- J. ASTM D6916 - Standard Test Method for Determining the Shear Strength Between Segmental Concrete Units
- K. ASTM C33 - Standard Specification for Concrete Aggregates (AASHTO M43)



### 1.3 Submittals

- A. Submit for review 2 sets of shop drawings for the retaining wall system prepared by a Professional Engineer registered in the state where the project is located. The shop drawings shall indicate the layout, height, and construction details of the retaining wall system. Design shall conform to relevant requirements and design methodologies of AASHTO Standard Specifications for Highway Bridges. Upon request, design calculations shall also be submitted. Minimum safety factors for design shall be as follows:

Gravity Wall  
Sliding 1.5  
Overturning 1.5  
Bearing 2.0

- B. Submit grain size test results for aggregates to be used for the wall base and for unit fill.
- C. Submit test results on borrow material to be used for common backfill and for select backfill (if used) including Proctor and grain size or Atterberg limits results.

### 1.4 Delivery, Storage, and Handling

- A. Contractor shall check the materials upon delivery to assure that proper materials have been received.
- B. Contractor shall protect the materials from damage. Damaged material shall not be incorporated into the wall or the reinforced soil embankments.
- C. Contractor shall prevent excessive mud, concrete, adhesives and other substances that may adhere from coming in contact with the materials.
- D. Exposed faces of precast modular block units shall be reasonably free of chips, cracks, or stains when viewed from a distance of 10 feet.

## PART 2 - PRODUCTS

### 2.1 Wall Units

- A. Wall units shall be precast modular blocks.
- B. Dimension tolerances for precast modular blocks shall be  $\pm 1/8$  inch for horizontal and vertical dimensions of the face and  $\pm 1/2$  to  $-1/4$  inch for the face to tail width.
- C. Concrete for precast modular blocks shall have a minimum 28-day compressive strength of 4,000psi. Entrained air content shall be between 5 and 7%.

- D. Reinforcing steel (if used) shall be Grade 60. Minimum clear cover to reinforcement shall be 1½ inches.
- E. The face pattern shall be selected from the manufacturer's standard molds. The color of the units shall be natural gray.

## **2.2 Wall Base**

- A. The wall base shall consist of dense graded crushed aggregate. A minimum of 75% of coarse material shall have 2 or more fractured faces. Wall base material shall meet the following gradation:

US Standard Sieve Size Percent Passing  
1-1/2" 80-100  
3/4" 50-90  
#4 0-40  
#200 0-10

- B. The contractor may substitute concrete with a minimum 28-day compressive strength of 3,000 psi for the granular base material. Concrete may be placed full thickness or as a topping over a compacted granular the base. If used as a topping, the concrete shall have a minimum thickness of 3 inches.

## **2.3 Unit Fill**

- A. Unit fill shall consist of a screened crushed aggregate. A minimum of 75% of coarse material shall have 2 or more fractured faces. Unit fill material shall meet the following gradation:

US Standard Sieve Size Percent Passing  
1-1/2" 100  
3/4" 50-75  
#4 0-40  
#200 0-5

## **2.4 Backfill**

- A. If a select granular reinforced zone is indicated, it shall consist of fill sand or other clean aggregate meeting the following gradation:

US Standard Sieve Size Percent Passing  
3/4" 100  
#200 0-5

- B. All other backfill behind and in front of the wall shall consist of suitable on-site soil or imported borrow and shall be approved by the Geotechnical Engineer. Backfill shall generally consist of sands, silts, or lean clays with a liquid limit less than 45 and a plasticity index less than 20. Fat clay soils, cobbles, and large rock should generally be avoided unless approved by the Geotechnical Engineer based on local practices. Frozen soils,

excessively wet or dry soils, debris, and deleterious materials should not be used.

## **Technical Data and Specifications**

### **2.5 Drain Tile**

- A. Drain tile shall be a perforated or slotted PVC or corrugated HDPE pipe. The drain tile should be connected to storm drains or daylighted at low points and/or periodically along the wall alignment as shown on the plans.

### **2.6 Geotextile Fabric**

- A. Provide a geotextile filter for separation from backfill at the tails of the blocks. The geotextile shall be a needle punched non-woven fabric with a minimum grab tensile strength of 120 pounds. The geotextile may cover the entire back face of the blocks or may be cut in strips to cover the gaps between tail units with a minimum of 6 inches of overlap over the concrete tail on both sides.

### **2.7 Concrete for Tail Extensions**

- A. Concrete for tail extensions shall have a minimum 28-day compressive strength of 3,000 psi. Higher mix strength may be necessary to achieve a strength of 2,000 psi before the wall is backfilled above the level of the tail extension.
- B. Concrete shall have entrained air content between 5% and 7%.

## **PART 3 - EXECUTION**

### **3.1 Excavation**

- A. Excavate as required for installation of the retaining wall system. Excavate to the base level for a sufficient distance behind the face to permit installation of the base.
- B. Slope or shore excavation as necessary for safety and for conformance with applicable OSHA requirements.

### **3.2 Wall Base**

- A. Foundation soils shall be excavated to the dimensions shown on the plans. Foundation soil shall be observed by the Engineer to confirm that the bearing soils are similar to the design conditions or assumptions.
- B. Construct the wall base to the lines and grades shown on the plans. Place and consolidate concrete, strike, and finish plane and level. Over excavated areas shall be filled with additional concrete or granular base material. Compact granular base material to provide a

hard and level surface to support the wall units. Base material shall be compacted to a minimum of 95 percent of the maximum dry density (ASTM D698, Standard Proctor). Final base elevation shall be within 0.1 feet of plan elevation.

- C. Prepare and smooth the granular material to ensure complete contact of the first course with the base. The base may be dressed with fine aggregate to aid leveling.

### **3.3 Unit Installation**

- A. Place the first course of units directly on the wall base. Check units for level and alignment. Units shall be within 1/8 inch of level from end to end and from front to back. Adjacent units should be in contact. If possible, begin placing units at the lowest section of the wall.
- B. Fill all voids between and within the blocks with granular unit fill. Additional unit fill is not required behind the units, but may be placed for the convenience of the contractor.
- C. Place backfill behind the units in maximum loose lifts of 8 inches and compact. Compact all backfill to a minimum of 95 percent of the maximum dry density (ASTM D698, Standard Proctor). For cohesive soils, the moisture content at the time of compaction should be adjusted to within -2 and +3 percent of optimum. Place backfill in successive lifts until level with the top of the facing unit.
- D. Remove all excess aggregate and other materials from the top of the units before laying up the next course.

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**SECTION 05 50 00**  
**METAL FABRICATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.
- B. Items specified.
  - 1. Support for Wall and Ceiling Mounted Items: (12, 14A, 14C)
  - 2. Frames: (24E)
  - 3. Guards
  - 4. Covers and Frames for Pits and Trenches.
  - 5. Gratings
  - 6. Safety Nosings
  - 7. Ladders
  - 8. Railings: (10)
  - 9. Catwalks and Platforms
  - 10. Trap Doors with Ceiling Hatch
  - 11. Sidewalk Access Doors

**1.2 RELATED WORK**

- A. Colors, finishes, and textures: Section 09 00 00, WATER STORAGE TANK PAINTING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:

Grating, each type	Floor plate
Trap door	Wheel guards
Ceiling hatch	Sidewalk Access door
Manhole Covers	Safety nosing

- C. Shop Drawings:
  - 1. Each item specified, showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors.
  - 2. Mark items requiring field assembly for erection identification and furnish erection drawings and instructions.

3. Provide templates and rough-in measurements as required.

D. Manufacturer's Certificates:

1. Anodized finish as specified.
2. Live load designs as specified.

E. Design Calculations for specified live loads including dead loads.

F. Furnish setting drawings and instructions for installation of anchors to be preset into concrete and masonry work, and for the positioning of items having anchors to be built into concrete or masonry construction.

**1.4 QUALITY ASSURANCE**

- A. Each manufactured product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.
- B. Each product type shall be the same and be made by the same manufacturer.
- C. Assembled product to the greatest extent possible before delivery to the site.
- D. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

**1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):  
B18.6.1-97.....Wood Screws  
B18.2.2-87(R2005).....Square and Hex Nuts
- C. American Society for Testing and Materials (ASTM):  
A36/A36M-08.....Structural Steel  
A47-99(R2009).....Malleable Iron Castings  
A48-03(R2008).....Gray Iron Castings  
A53-10.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated  
Welded and Seamless  
A123-09.....Zinc (Hot-Dip Galvanized) Coatings on Iron and  
Steel Products  
A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel  
Steel Plate, Sheet and Strip  
A269-10.....Seamless and Welded Austenitic Stainless Steel  
Tubing for General Service  
A307-10.....Carbon Steel Bolts and Studs, 60,000 PSI Tensile  
Strength

- A312/A312M-09.....Seamless, Welded, and Heavily Cold Worked  
Austenitic Stainless Steel Pipes
- A391/A391M-07.....Grade 80 Alloy Steel Chain
- A653/A653M-10.....Steel Sheet, Zinc Coated (Galvanized) or Zinc-  
Iron Alloy Coated (Galvannealed) by the Hot-Dip  
Process
- A786/A786M-09.....Rolled Steel Floor Plate
- B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods,  
Wire, Shapes, and Tubes
- B456-03 (R2009).....Electrodeposited Coatings of Copper Plus Nickel  
Plus Chromium and Nickel Plus Chromium
- B632-08.....Aluminum-Alloy Rolled Tread Plate
- C1107-08.....Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- D3656-07.....Insect Screening and Louver Cloth Woven from  
Vinyl-Coated Glass Yarns
- F436-10.....Hardened Steel Washers
- F468-10.....Nonferrous Bolts, Hex Cap Screws, and Studs for  
General Use
- F593-02 (R2008).....Stainless Steel Bolts, Hex Cap Screws, and Studs
- F1667-11.....Driven Fasteners: Nails, Spikes and Staples
- D. American Welding Society (AWS):
  - D1.1-10.....Structural Welding Code Steel
  - D1.2-08.....Structural Welding Code Aluminum
  - D1.3-08.....Structural Welding Code Sheet Steel
- E. National Association of Architectural Metal Manufacturers (NAAMM)
  - AMP 521-01.....Pipe Railing Manual
  - AMP 500-06.....Metal Finishes Manual
  - MBG 531-09.....Metal Bar Grating Manual
  - MBG 532-09.....Heavy Duty Metal Bar Grating Manual
- F. Structural Steel Painting Council (SSPC)/Society of Protective Coatings:
  - SP 1-04.....No. 1, Solvent Cleaning
  - SP 2-04.....No. 2, Hand Tool Cleaning
  - SP 3-04.....No. 3, Power Tool Cleaning
- G. Federal Specifications (Fed. Spec):
  - RR-T-650E.....Treads, Metallic and Nonmetallic, Nonskid

## **PART 2 - PRODUCTS**

### **2.1 DESIGN CRITERIA**

- A. In addition to the dead loads, design fabrications to support the following live loads unless otherwise specified.
- B. Ladders and Rungs: 250 pounds at any point.
- C. Railings and Handrails: 200 pounds in any direction at any point.

- D. Floor Plates, Gratings, Covers, Trap Doors, Catwalks, and Platforms: 100 pounds per square foot. Use 300 pounds for concentrated loads.
- E. Manhole Covers: 250 pounds per square foot.

## **2.2 MATERIALS**

- A. Structural Steel: ASTM A36.
- B. Stainless Steel: ASTM A167, Type 302 or 304.
- C. Aluminum, Extruded: ASTM B221, Alloy 6063-T5 unless otherwise specified.  
For structural shapes use alloy 6061-T6 and alloy 6061-T4511.
- D. Floor Plate:
  - 1. Steel ASTM A786.
  - 2. Aluminum: ASTM B632.
- E. Steel Pipe: ASTM A53.
  - 1. Galvanized for exterior locations.
  - 2. Type S, Grade A unless specified otherwise.
  - 3. NPS (inside diameter) as shown.
- F. Cast-Iron: ASTM A48, Class 30, commercial pattern.
- G. Malleable Iron Castings: A47.
- H. Stainless Steel Tubing: ASTM A269, type 302 or 304.
- I. Modular Channel Units:
  - 1. Factory fabricated, channel shaped, cold formed sheet steel shapes, complete with fittings bolts and nuts required for assembly.
  - 2. Form channel within turned pyramid shaped clamping ridges on each side.
  - 3. Provide case hardened steel nuts with serrated grooves in the top edges designed to be inserted in the channel at any point and be given a quarter turn so as to engage the channel clamping ridges. Provide each nut with a spring designed to hold the nut in place.
  - 4. Factory finish channels and parts with oven baked primer when exposed to view. Channels fabricated of ASTM A525, G90 galvanized steel may have primer omitted in concealed locations. Finish screws and nuts with zinc coating.
  - 5. Fabricate snap-in closure plates to fit and close exposed channel openings of not more than 0.0125 inch thick stainless steel.
- J. Grout: ASTM C1107, pourable type.
- K. Insect Screening: ASTM D3656.

## **2.3 HARDWARE**

- A. Rough Hardware:
  - 1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electro-galvanizing process. Galvanized G-90 where specified.



2. Use G90 galvanized coating on ferrous metal for exterior work unless non-ferrous metal or stainless is used.

B. Fasteners:

1. Bolts with Nuts:

- a. ASME B18.2.2.
- b. ASTM A307 for 60,000 psi tensile strength bolts.
- c. ASTM F468 for nonferrous bolts.
- d. ASTM F593 for stainless steel.

2. Screws: ASME B18.6.1.

3. Washers: ASTM F436, type to suit material and anchorage.

4. Nails: ASTM F1667, Type I, style 6 or 14 for finish work.

**2.4 FABRICATION GENERAL**

A. Material

1. Use material as specified. Use material of commercial quality and suitable for intended purpose for material that is not named or its standard of quality not specified.
2. Use material free of defects which could affect the appearance or service ability of the finished product.

B. Size:

1. Size and thickness of members as shown.
2. When size and thickness is not specified or shown for an individual part, use size and thickness not less than that used for the same component on similar standard commercial items or in accordance with established shop methods.

C. Connections

1. Except as otherwise specified, connections may be made by welding, riveting or bolting.
2. Field riveting will not be approved.
3. Design size, number and placement of fasteners, to develop a joint strength of not less than the design value.
4. Holes, for rivets and bolts: Accurately punched or drilled and burrs removed.
5. Size and shape welds to develop the full design strength of the parts connected by welds and to transmit imposed stresses without permanent deformation or failure when subject to service loadings.
6. Use Rivets and bolts of material selected to prevent corrosion (electrolysis) at bimetallic contacts. Plated or coated material will not be approved.
7. Use stainless steel connectors for removable members machine screws or bolts.

D. Fasteners and Anchors

1. Use methods for fastening or anchoring metal fabrications to building construction as shown or specified.
2. Where fasteners and anchors are not shown, design the type, size, location and spacing to resist the loads imposed without deformation of the members or causing failure of the anchor or fastener, and suit the sequence of installation.
3. Use material and finish of the fasteners compatible with the kinds of materials which are fastened together and their location in the finished work.
4. Fasteners for securing metal fabrications to new construction only, may be by use of threaded or wedge type inserts or by anchors for welding to the metal fabrication for installation before the concrete is placed or as masonry is laid.
5. Fasteners for securing metal fabrication to existing construction or new construction may be expansion bolts, toggle bolts, power actuated drive pins, welding, self drilling and tapping screws or bolts.

E. Workmanship

1. General:
  - a. Fabricate items to design shown.
  - b. Furnish members in longest lengths commercially available within the limits shown and specified.
  - c. Fabricate straight, true, free from warp and twist, and where applicable square and in same plane.
  - d. Provide holes, sinkages and reinforcement shown and required for fasteners and anchorage items.
  - e. Provide openings, cut-outs, and tapped holes for attachment and clearances required for work of other trades.
  - f. Prepare members for the installation and fitting of hardware.
  - g. Cut openings in gratings and floor plates for the passage of ducts, sumps, pipes, conduits and similar items. Provide reinforcement to support cut edges.
  - h. Fabricate surfaces and edges free from sharp edges, burrs and projections which may cause injury.
2. Welding:
  - a. Weld in accordance with AWS.
  - b. Welds shall show good fusion, be free from cracks and porosity and accomplish secure and rigid joints in proper alignment.
  - c. Where exposed in the finished work, continuous weld for the full length of the members joined and have depressed areas filled and protruding welds finished smooth and flush with adjacent surfaces.
  - d. Finish welded joints to match finish of adjacent surface.

3. Joining:

- a. Miter or butt members at corners.
- b. Where frames members are butted at corners, cut leg of frame member perpendicular to surface, as required for clearance.

4. Anchors:

- a. Where metal fabrications are shown to be preset in concrete, weld 1-1/4 by 1/8 inch steel strap anchors, 6 inches long with one inch hooked end, to back of member at 2 feet on center, unless otherwise shown.
- b. Where metal fabrications are shown to be built into masonry use 1-1/4 by 1/8 inch steel strap anchors, 10 inches long with 2 inch hooked end, welded to back of member at 2 feet on center, unless otherwise shown.

5. Cutting and Fitting:

- a. Accurately cut, machine and fit joints, corners, copes, and miters.
- b. Fit removable members to be easily removed.
- c. Design and construct field connections in the most practical place for appearance and ease of installation.
- d. Fit pieces together as required.
- e. Fabricate connections for ease of assembly and disassembly without use of special tools.
- f. Joints firm when assembled.
- g. Conceal joining, fitting and welding on exposed work as far as practical.
- h. Do not show rivets and screws prominently on the exposed face.
- i. The fit of components and the alignment of holes shall eliminate the need to modify component or to use exceptional force in the assembly of item and eliminate the need to use other than common tools.

F. Finish:

- 1. Finish exposed surfaces in accordance with NAAMM Metal Finishes Manual.
- 2. Aluminum: NAAMM AMP 501.
  - a. Mill finish, AA-M10, as fabricated, use unless specified otherwise.
  - b. Clear anodic coating, AA-C22A41, chemically etched medium matte, with Architectural Class 1, 0.7 mils or thicker.
  - c. Colored anodic coating, AA-C22A42, chemically etched medium matte with Architectural Class 1, 0.7 mils or thicker.
  - d. Painted: AA-C22R10.

3. Steel and Iron: NAAMM AMP 504.
  - a. Zinc coated (Galvanized): ASTM A123, G90 unless noted otherwise.
  - b. Surfaces exposed in the finished work:
    - 1) Finish smooth rough surfaces and remove projections.
    - 2) Fill holes, dents and similar voids and depressions with epoxy type patching compound.
  - c. Shop Prime Painting:
    - 1) Surfaces of Ferrous metal:
      - a) Items not specified to have other coatings.
      - b) Galvanized surfaces specified to have prime paint.
      - c) Remove all loose mill scale, rust, and paint, by hand or power tool cleaning as defined in SSPC-SP2 and SP3.
      - d) Clean of oil, grease, soil and other detrimental matter by use of solvents or cleaning compounds as defined in SSPC-SP1.
      - e) After cleaning and finishing apply one coat of primer.
    - 2) Non ferrous metals: Comply with MAAMM-500 series.
4. Stainless Steel: NAAMM AMP-504 Finish No. 4.
5. Chromium Plating: ASTM B456, satin or bright as specified, Service Condition No. SC2.

G. Protection:

1. Insulate aluminum surfaces that will come in contact with concrete, masonry, plaster, or metals other than stainless steel, zinc or white bronze by giving a coat of heavy-bodied alkali resisting bituminous paint or other approved paint in shop.
2. Spot prime all abraded and damaged areas of zinc coating which expose the bare metal, using zinc rich paint on hot-dip zinc coat items and zinc dust primer on all other zinc coated items.

## 2.5 SUPPORTS

A. General:

1. Fabricate ASTM A36 structural steel shapes as shown.
2. Use clip angles or make provisions for welding hangers and braces to overhead construction.
3. Field connections may be welded or bolted.

B. For Ceiling Hung Toilet Stall:

1. Use a continuous steel channel above pilasters with hangers centered over pilasters.
2. Make provision for installation of stud bolts in lower flange of channel.

3. Provide a continuous steel angle at wall and channel braces spaced as shown.
  4. Use threaded rod hangers.
  5. Provide diagonal angle brace where the suspended ceiling over toilet stalls does not extend to side wall of room.
- C. For Wall Mounted Items:
1. For items supported by metal stud partitions.
  2. Steel strip or hat channel minimum of 0.0598 inch thick.
  3. Steel strip minimum of 6 inches wide, length extending one stud space beyond end of item supported.
  4. Steel hat channels where shown. Flange cut and flattened for anchorage to stud.
  5. Structural steel tube or channel for grab bar at water closets floor to structure above with clip angles or end plates formed for anchors.
  6. Use steel angles for thru wall counters. Drill angle for fasteners at ends and not over 4 inches on center between ends.
- D. For Trapeze Bars:
1. Construct assembly above ceilings as shown and design to support not less than a 750 pound working load at any point.
  2. Fabricate trapeze supports as shown, with all exposed members, including screws, nuts, bolts and washers, fabricated of stainless steel.
  3. Fabricate concealed components of structural steel shapes unless shown otherwise.
  4. Stainless steel ceiling plate drilled for eye bolt.
  5. Continuously weld connections where welds shown.
  6. Use modular channel where shown with manufacturers bolts and fittings.
    - a. Weld ends of steel angle braces to steel plates and secure to modular channel units as shown. Drill plates for anchor bolts.
    - b. Fabricate eye bolt, special clamp bolt, and plate closure full length of modular channel at ceiling line and secure to modular channel unit with manufacturers standard fittings.
- E. For Intravenous Track and Cubical Curtain Track:
1. Fabricate assembly of steel angle as shown.
  2. Drill angle bent ends for anchor screws to acoustical suspension system and angle for hanger wires.
  3. Provide pipe sleeve welded to angle.
- F. Supports at Ceiling for Radiographic (x-ray) Equipment:
1. Fabricate hangers braces, and track of modular channel units assembly as shown.

2. Fabricate steel plates for anchor to structure above.
  3. Drill bent plates for bolting at mid height at concrete beams.
- G. For Operating Room Light:
1. Fabricate as shown to suit equipment furnished.
  2. Drill leveling plate for light fixture bolts.
- H. Supports in Orthopedic Brace Shop:
1. Fabricate from one inch steel pipe, fasten to steel angles above and extend to a point 6 inches) below finished ceiling.
  2. Lower end of the pipe shall have a standard pipe thread.
  3. Provide an escutcheon plate at ceiling.
- I. Supports for Accordion Partition Tracks, Exercise Equipment, and Items at Various Conditions at Suspended Ceilings:
1. Fabricate of structural steel shapes as shown.
  2. Drill for anchor bolts of suspended item.
- J. Supports for Communion Rail Posts in Chapel:
1. Fabricate one steel plate support for each post as shown.
  2. Drill for fasteners.

## **2.6 FRAMES**

- A. Channel Door Frames:
1. Fabricate of structural steel channels of size shown.
  2. Miter and weld frames at corners.
  3. Where anchored to masonry or embedded in concrete, weld to back of frame at each jamb, 3/16 inch thick by 1-3/4 inch wide steel strap anchors with ends turned 2 inches, and of sufficient length to extend at least 12 inches into wall. Space anchors 24 inches above bottom of frame and 24 inches o.c. to top of jamb. Weld clip angles to bottom of jambs and provide holes for expansion bolts.
  4. Where anchored to concrete or masonry in prepared openings, drill holes at jambs for anchoring with expansion bolts. Weld clip angles to bottom of frame and provide holes for expansion bolt anchors as shown. Drill holes starting 24 inches above bottom of frame and 24 inches o.c. to top of jamb and at top of jamb. Provide pipe spacers at holes welded to channel.
  5. Where closure plates are shown, continuously weld them to the channel flanges.
  6. Weld continuous 3/4 x 3/4 x 1/8 inch thick steel angles to the interior side of each channel leg at the head and jambs to form a caulking groove.
- B. Frames for Breech Opening:
1. Fabricate from steel channels, or combination of steel plates and angles to size and contour shown.

2. Weld strap anchors on back of frame at not over 2 feet on centers for concrete or masonry openings.

C. Frames for Lead Lined Doors:

1. Obtain accurate dimensions and templates from suppliers of lead lined doors, finish hardware, and hollow steel door frames.
2. Fabricate as shown for use in connection with lead lined doors.
3. Deliver assembled frames with removable shipping spreaders at top and bottom.
4. Extend angles at jambs from floor to structural slab above. At floors of interstitial spaces, terminate jamb sections and provide anchors as shown.
5. Continuously weld plates and reinforcements to frame members and head members of angle frames between jambs.
6. Weld strap anchors, not over 24 inches on centers, to the back of angles for embedment in masonry or concrete unless shown otherwise.
7. Type 15 Door Frames:
  - a. Structural steel angle frames with plate or bar full height to heads. Extend reinforcing at hinge cutouts two inches beyond cutout.
  - b. Fabricate top anchorage to beam side at mid height.
  - c. Weld clip angles to both legs of angle at top and bottom.
  - d. Drill clips and plates, at top and bottom for anchoring jamb angles with two 3/8 inch expansion bolts at each location.
  - e. Cut rabbet for pivot hinges and lock strike.

## 2.7 GUARDS

A. Wall Corner Guards:

1. Fabricate from steel angles and furnish with anchors as shown.
2. Continuously weld anchor to angle.

B. Guard Angles for Overhead Doors:

1. Cut away top portion of outstanding leg of angle and extend remaining portion of angle up wall.
2. Weld filler piece across head of opening to jamb angles.
3. Make provisions for fasteners and anchorage.

C. Channel Guard at Loading Platform:

1. Fabricate from steel channel of size shown.
2. Weld anchors to channels as shown.
3. Drill channel for bumper anchor bolts.

D. Edge Guard Angles for Openings in slabs.

1. Fabricate from steel angles of sizes and with anchorage shown.

2. Where size of angle is not shown, provide 2 x 2 x 1/4 inch steel angle with 1-1/4 x 3/16 inch strap anchors, welded to back.
3. Miter or butt angles at corners and weld.
4. Use one anchor near end and three feet on centers between end anchors.

E. Wheel Guards:

1. Construct wheel guards of not less than 5/8 inch thick cast iron.
2. Provide corner type, with flanges for bolting to walls.

**2.8 COVERS AND FRAMES FOR PITS AND TRENCHES**

A. Fabricate covers to support live loads specified.

B. Galvanized steel members after fabrication in accordance with ASTM A123, G-90 coating.

C. Steel Covers:

1. Use 1/4 inch thick floor plate for covers unless otherwise shown. Use gratings where shown as specified in paragraph GRATINGS. Use smooth floor plate unless noted otherwise.
2. Provide clearance at all sides to permit easy removal of covers.
3. Make cutouts within 1/4 inch of penetration for passage of pipes and ducts.
4. Drill covers for flat head countersunk screws.
5. Make cover sections not to exceed 25 square feet in area and 200 pounds in weight.
6. Fabricate trench cover sections not be over 3 feet long and if width of trench is more than 3 feet or over, equip one end of each section with an angle or "T" bar stiffener to support adjoining plate.
7. Use two, 1/2 inch diameter steel bar flush drop handles for each cover section.

D. Cast Iron Covers

1. Fabricate covers to support live loads specified.
2. Fabricate from ASTM A48, cast-iron, 1/2 inch minimum metal thickness, cast with stiffeners as required.
3. Fabricate as flush type with frame, reasonably watertight and be equipped with flush type lifting rings. Provide seals where watertight covers noted.
4. Make covers in sections not over 200 pounds except round covers.

E. Steel Frames:

1. Form frame from structural steel angles as shown. Where not shown use 2-1/2 x 2-1/2 x 1/4 inch angles for frame openings over 4 feet long and 2 ix 2 x 1/4 inch for frame openings less than 4 feet.



2. Fabricate intermediate supporting members from steel "T's" or angles; located to support cover section edges.
3. Where covers are required use steel border bars at frames so that top of cover will be flush with frame and finish floor.
4. Weld steel strap anchors to frame. Space straps not over 24 inches o.c., not shown otherwise between end anchors. Use 1/4 x 1 x 8 inches with 2 inch bent ends strap anchors unless shown otherwise.
5. Drill and tap frames for screw anchors where plate covers occur.

F. Cast Iron Frames:

1. Fabricate from ASTM A48 cast iron to shape shown.
2. Provide anchors for embedding in concrete, spaced near ends and not over 24 inches apart.

**2.9 GRATINGS**

- A. Fabricate gratings to support live loads specified and a concentrated load as specified.
- B. Provide clearance at all sides to permit easy removal of grating.
- C. Make cutouts in gratings with 1/4 inch minimum to one inch maximum clearance for penetrations or passage of pipes and ducts. Edge band cutouts.
- D. Fabricate in sections not to exceed 25 square feet in area and 200 pounds in weight.
- E. Fabricate sections of grating with end-banding bars.
- F. Fabricate angle frames and supports, including anchorage as shown.
  1. Fabricate intermediate supporting members from "T's" or angles.
  2. Locate intermediate supports to support grating section edges.
  3. Fabricate frame to finish flush with top of grating.
  4. Locate anchors at ends and not over 24 inches o.c.
  5. Butt or miter, and weld angle frame at corners.

G. Steel Bar Gratings:

1. Fabricate grating using steel bars, frames, supports and other members shown in accordance with Metal Bar Grating Manual.
2. Galvanize steel members after fabrication in accordance with ASTM A123, G-90 for exterior gratings, gratings in concrete floors, and interior grating where specified.
3. Interior gratings: Prime paint unless specified galvanized.
4. Use serrated bars for exterior gratings and interior gratings in the following areas:
5. Use riveted grating in the following areas:

H. Aluminum Bar Gratings:

1. Fabricate grating and frame assembly from aluminum as shown in accordance with Metal Bar Grating Manual.
2. Use 1 x 3/16 inch minimum size bearing bars.
3. Mill finish unless specified otherwise.
4. Use serrated bars for exterior gratings and interior gratings in the following areas:
  - I. Plank Gratings:
    1. Conform to Fed. Spec. RR-G-1602.
    2. Manufacturers standard widths, lengths and side channels to meet live load requirements.
    3. Galvanize exterior steel gratings ASTM A123, G-90 after fabrication.
    4. Fabricate interior steel gratings from galvanized steel sheet, ASTM A525, where bearing on concrete or masonry.
    5. Fabricate other interior grating from steel sheet and finish with shop prime paint. Prime painted galvanized sheet may be used.
  - J. Cast Iron Gratings:
    1. Fabricate gratings to support a live load of 500 pounds per square foot.
    2. Fabricate gratings and frames for gutter type drains from cast-iron conforming to ASTM A48.
    3. Fabricate gratings in section not longer than 4 feet or over 200 pounds and fit so as to be readily removable.

## **2.10 SHELF ANGLES**

- A. Fabricate from steel angles of size shown.
- B. Fabricate angles with horizontal slotted holes for 3/4 inch bolts spaced at not over 3 feet on centers and within 12 inches of ends.
- C. Provide adjustable malleable iron inserts for embedded in concrete framing.

## **2.11 PLATE DOOR SILL**

- A. Fabricate of checkered plate as detailed.
  1. Aluminum Plate: ASTM B632, 0.125 inch thick.
  2. Steel Plate: ASTM A786, 0.125 inch thick, galvanized G90.
- B. Fabricate for anchorage with flat head countersunk bolts at each end and not over 12 inches, o.c.

## **2.12 LADDERS**

- A. Steel Ladders:
  1. Fixed-rail type with steel rungs shouldered and headed into and welded to rails.

2. Fabricate angle brackets of 2 inch wide by 1/2 inch thick steel; brackets spaced maximum of 4 feet apart and of length to hold ladder 7 inches from wall to center of rungs. Provide turned ends or clips for anchoring.
3. Provide holes for anchoring with expansion bolts through turned ends and brackets.
4. Where shown, fabricate side rails curved, twisted and formed into a gooseneck.
5. Galvanize exterior ladders after fabrication, ASTM A123, G-90.

B. Aluminum Ladders:

1. Fixed-rail type, constructed of structural aluminum, with mill finish.
2. Fabricate side rails and rungs of size and design shown, with the rungs shouldered and headed into and welded to the rails.
3. Where shown fabrication side rails curved, twisted and formed into gooseneck.
4. Fabricate angle brackets at top and bottom and intermediate brackets where shown. Drill for bolting.

C. Ladder Rungs:

1. Fabricate from one inch diameter steel bars.
2. Fabricate so that rungs will extend at least 4 inches into wall with ends turned 2 inches, project out from wall 7 inches, be 16 inches wide and be designed so that foot cannot slide off end.
3. Galvanized after fabrication, ASTM A123, G-90 rungs for exterior use and for access to pits.

## **2.13 RAILINGS**

- A. In addition to the dead load design railing assembly to support live load specified.

B. Fabrication General:

1. Provide continuous welded joints, dressed smooth and flush.
2. Standard flush fittings, designed to be welded, may be used.
3. Exposed threads will not be approved.
4. Form handrail brackets to size and design shown.
5. Exterior Post Anchors.
  - a. Fabricate tube or pipe sleeves with closed ends or plates as shown.
  - b. Where inserts interfere with reinforcing bars, provide flanged fittings welded or threaded to posts for securing to concrete with expansion bolts.

- c. Provide heavy pattern sliding flange base plate with set screws at base of pipe or tube posts. Base plates are not required on pipe sleeves where ornamental railings occur.
- 6. Interior Post Anchors:
  - a. Provide flanged fittings for securing fixed posts to floor with expansion bolts, unless shown otherwise.
  - b. Weld or thread flanged fitting to posts at base.
  - c. For securing removable posts to floor, provide close fitting sleeve insert or inverted flange base plate with stud bolts or rivets concrete anchor welded to the base plate.
  - d. Provide sliding flange base plate on posts secured with set screws.
  - e. Weld flange base plate to removable posts set in sleeves.
- C. Handrails:
  - 1. Close free ends of rail with flush metal caps welded in place except where flanges for securing to walls with bolts are shown.
  - 2. Make provisions for attaching handrail brackets to wall, posts, and handrail as shown.
- D. Steel Pipe Railings:
  - 1. Fabricate of steel pipe with welded joints.
  - 2. Number and space of rails as shown.
  - 3. Space posts for railings not over 6 feet on centers between end posts.
  - 4. Form handrail brackets from malleable iron.
  - 5. Fabricate removable sections with posts at end of section.
  - 6. Removable Rails:
    - a. Provide "U" shape brackets at each end to hold removable rail as shown. Use for top and bottom horizontal rail when rails are joined together with vertical members.
    - b. Secure rail to brackets with 3/8 inch stainless steel through bolts and nuts at top rail only when rails joined with vertical members.
    - c. Continuously weld brackets to post.
    - d. Provide slotted bolt holes in rail bracket.
    - e. Weld bolt heads flush with top of rail.
    - f. Weld flanged fitting to post where posts are installed in sleeves.
  - 7. Opening Guard Rails:
    - a. Fabricate rails with flanged fitting at each end to fit between wall opening jambs.
    - b. Design flange fittings for fastening with machine screws to steel plate anchored to jambs.

- c. Fabricate rails for floor openings for anchorage in sleeves.
- 8. Gates:
  - a. Fabricate from steel pipe as specified for railings.
  - b. Fabricate gate fittings from either malleable iron or wrought steel.
  - c. Hang each gate on suitable spring hinges of clamp on or through bolted type. Use bronze hinges for exterior gates.
  - d. Provide suitable stops, so that gate will swing as shown.
  - e. Provide padlock eyes where shown.
- 9. Chains:
  - a. Chains: ASTM A391, Grade 63, straight link style, normal size chain bar 5/16 inch diameter, eight links per foot and with boat type snap hook on one end, and through type eye bolt on other end.
  - b. Fabricate eye bolt for attaching chain to pipe posts, size not less than 3/8 inch diameter.
  - c. Fabricate anchor at walls, for engagement of snap hook of either a 3/8 inch diameter eye bolt or punched angle.
  - d. Galvanize chain and bolts after fabrication.
- E. Aluminum Railings:
  - 1. Fabricate from extruded aluminum.
  - 2. Use tubular posts not less than 0.125 inch wall thickness for exterior railings.
  - 3. Punch intermediate rails and bottom of top rails for passage of posts and machine to a close fit.
  - 4. Where shown use extruded channel sections for top rail with 1/2 inch thick top cover plates and closed ends.
  - 5. Fabricate brackets of extruded or wrought aluminum as shown.
  - 6. Fabricate stainless pipe sleeves with closed bottom at least six inches deep having internal dimensions at least 1/2 inch greater than external dimensions of posts where set in concrete.
- F. Stainless Steel Railings:
  - 1. Fabricate from 1-1/2 inches outside diameter stainless steel tubing, ASTM A269, having a wall thickness of 0.065 inch.
  - 2. Join sections by an internal connector to form hairline joints where field assembled.
  - 3. Fabricate with continuous welded connections.
  - 4. Fabricate brackets of stainless steel to design shown.
  - 5. Fabricate stainless steel sleeves at least 6 inches deep having internal dimensions at least 1/2 inch greater than external dimensions of post.

#### **2.14 CATWALKS**

- A. Fabricate catwalks including platforms, railings, ladders, supports and hangers, and arrangement of members as shown on drawings.
- B. Fabricate steel ladders as specified under paragraph LADDERS unless shown otherwise.
- C. Fabricate steel pipe railings as specified under paragraph RAILINGS.
- D. Catwalk and platforms floor surfaces as shown.
  - 1. Steel gratings as specified under paragraph gratings, either bar or plank type.
  - 2. Steel floor plate.
  - 3. Aluminum floor plate.
- E. Prime paint catwalk system.

#### **2.15 TRAP DOOR AND FRAMES WITH CEILING HATCH**

- A. Design to support a live load as specified.
- B. Frames:
  - 1. Fabricate steel angle frame to set in concrete slabs and design to set flush with finished concrete slab or curb. If not shown use 2-1/2 x 2-1/2 x 1/4 inch angles.
  - 2. Miter steel angles at corners and weld together.
  - 3. Weld steel bar stops to vertical leg of frame, to support doors flush with the top of the frame.
  - 4. Weld steel strap anchors on each side not over 24 inches on center to the backs of the frames. If not shown use 1/4 x 2 x 8 inch long straps with 2 inch bent ends.
  - 5. Form frames from steel angles with welded corners for reinforcing and bracing of well lining and support of ceiling hatch.
- C. Covers:
  - 1. Use 1/4 inch thick steel floor plate.
  - 2. Where double leaf covers are shown, reinforce at meeting edges.
  - 3. Use wrought steel hinges with fixed brass pins.
    - a. Weld to cover.
    - b. Secure to frame with machine screws.
  - 4. Where ladders occur, install hinges on the side opposite the ladder.
  - 5. Provide two bar type drop handles, flush with cover when closed for each leaf.
- D. Well Lining:
  - 1. Fabricate well linings, for access through concrete floor slabs and suspended ceilings, from hatch to ceiling hatch or ceiling openings.
  - 2. Use steel sheet and shapes of size and thickness as shown. If not shown use 0.0598 inch thick steel sheet.

3. If not shown use 2 x 2 x 1/4 inch angle braces from ceiling level on each side angled at 45 degrees to structure above.
4. Use 1 x 1 x 1/8 inch angle bottom flange trim welded to well lining where no ceiling hatch occurs.

E. Ceiling Hatch:

1. Construct hatch with "T" or angle frame designed to support edge of ceiling and hatch, weld to well lining.
2. Form hatch panels of 1/8 inch steel, 3/16 inch aluminum or 0.0359 inch thick steel of pan type construction with one inch of mineral fiber insulation between.
3. Use counter balance device, hinges, latch, hangers and other accessories required for installation and operation of hatch with not over 20 pounds of force.
4. Fabricate panels flush and reinforced to remain flat.
5. Locate hatch panel flush with frame.

F. Finish with baked on prime coat.

## **2.16 SCREENED ACCESS DOORS AND FRAMES**

A. Galvanized ASTM A123, G-90 after fabrication.

B. Wall frame:

1. Fabricate frame from steel angles or channels as shown.
2. Continuously weld 1-1/2 x 1/2 inch steel channel door stop to angle frame. Cut out lock strike opening in channel.
3. Miter and weld channel frame at corners. Reinforce corner with 1/8 inch plate angle.
4. Reinforce channel frame with 1/8 x 6 inch long steel plate at channel back to cut out for latch. Cutout lock strike opening in channel face. Drill and tap for hinge anchorage.
5. Drill jambs for 1/4 inch bolt anchors at top and bottom and not over 18 inches between top and bottom.
6. Fabricate frame for door to sit flush with face of frame.

C. Doors

1. Fabricate door using steel channel frame with 1/8 inch angle plate reinforcing at corners.
2. Miter and weld corners.
3. Fabricate lock box of 1/16 inch plate and weld to channel surround.
4. Provide wire mesh constructed of 0.135 inch diameter galvanized steel wire crimped and woven into 1-1/2 inch diamond mesh pattern. Fasten the wire mesh to door frames by bending the ends of each strand of wire over through channel clinched and welded to channel door frame.

5. Weld steel plate back-bands to channel door frame at hinge stiles only.
6. Screen on doors in exterior walls.
  - a. Fabricate rewirable frame for screen from either extruded or tubular aluminum.
  - b. Design to allow for removing or replacement frame and screening or adjoining items without damage.
  - c. Use aluminum insect screening specified.
  - d. Use stainless steel fasteners for securing screen to door.
- D. Hardware:
  1. Install hinged door to fixed frame with two 2-1/2 inch brass or bronze hinges.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Set work accurately, in alignment and where shown, plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.
- B. Items set into concrete or masonry.
  1. Provide temporary bracing for such items until concrete or masonry is set.
  2. Place in accordance with setting drawings and instructions.
  3. Build strap anchors, into masonry as work progresses.
- C. Set frames of gratings, covers, corner guards, trap doors and similar items flush with finish floor or wall surface and, where applicable, flush with side of opening.
- D. Field weld in accordance with AWS.
  1. Design and finish as specified for shop welding.
  2. Use continuous weld unless specified otherwise.
- E. Install anchoring devices and fasteners as shown and as necessary for securing metal fabrications to building construction as specified. Power actuated drive pins may be used except for removable items and where members would be deformed or substrate damaged by their use.
- F. Spot prime all abraded and damaged areas of zinc coating as specified and all abraded and damaged areas of shop prime coat with same kind of paint used for shop priming.
- G. Isolate aluminum from dissimilar metals and from contact with concrete and masonry materials as required to prevent electrolysis and corrosion.
- H. Secure escutcheon plate with set screw.

#### **3.2 INSTALLATION OF SUPPORTS**

- A. Anchorage to structure.



1. Secure angles or channels and clips to overhead structural steel by continuous welding unless bolting is shown.
  2. Secure supports to concrete inserts by bolting or continuous welding as shown.
  3. Secure supports to mid height of concrete beams when inserts do not exist with expansion bolts and to slabs, with expansion bolts. unless shown otherwise.
  4. Secure steel plate or hat channels to studs as detailed.
- B. Ceiling Hung Toilet Stalls:
1. Securely anchor hangers of continuous steel channel above pilasters to structure above.
  2. Bolt continuous steel angle at wall to masonry or weld to face of each metal stud.
  3. Secure brace for steel channels over toilet stall pilasters to wall angle supports with bolts at each end spaced as shown.
  4. Install diagonal angle brace where the suspended ceiling over toilet stalls does not extend to side wall of room.
  5. Install stud bolts in lower flange of channel before installing furred down ceiling over toilet stalls.
  6. Install support for ceiling hung pilasters at entrance screen to toilet room similar to toilet stall pilasters.
- C. Supports for Wall Mounted items:
1. Locate center of support at anchorage point of supported item.
  2. Locate support at top and bottom of wall hung cabinets.
  3. Locate support at top of floor cabinets and shelving installed against walls.
  4. Locate supports where required for items shown.
- D. Support at Ceiling for X-ray Tube Stand and Radiographic Equipment:
1. Bolt modular steel channel frames to hangers as shown, anchored to structure above.
  2. Fasten frames with modular channel manufacturers fittings, bolts, and nuts. Space modular channel supports and hangers as shown and as required to suit equipment furnished.
  3. Install closure plates in channels at ceiling where channel opening is visible. Coordinate and cut plates to fit tight against equipment anchors after equipment anchors are installed.
- E. Ceiling Support for Operating Light:
1. Anchor support to structure above as shown.
  2. Set leveling plate as shown level with ceiling.
  3. Secure operating light to leveling plate in accordance with light manufacturer's requirements.

F. Supports for intravenous (IV) Track and Cubicle Curtain Track:

1. Install assembly where shown after ceiling suspension grid is installed.
2. Drill angle for bolt and weld nut to angle prior to installation of tile.

G. Support for cantilever grab bars:

1. Locate channels or tube in partition for support as shown, and extend full height from floor to underside of structural slab above.
2. Anchor at top and bottom with angle clips bolted to channels or tube with two, 3/8 inch diameter bolts.
3. Anchor to floors and overhead construction with two 3/8 inch diameter bolts.
4. Fasten clips to concrete with expansion bolts, and to steel with machine bolts or welds.

H. Supports for Trapeze Bars:

1. Secure plates to overhead construction with fasteners as shown.
2. Secure angle brace assembly to overhead construction with fasteners as shown and bolt plate to braces.
3. Fit modular channel unit flush with finish ceiling, and secure to plate with modular channel unit manufacturer's standard fittings through steel shims or spreaders as shown.
  - a. Install closure plates in channel between eye bolts.
  - b. Install eyebolts in channel.

I. Support for Communion Rail Posts:

1. Anchor steel plate supports for posts as shown.
2. Use four bolts per plate, locate two at top and two at bottom.
3. Use lag bolts.

**3.3 COVERS AND FRAMES FOR PITS AND TRENCHES**

- A. Set frame and cover flush with finish floor.
- B. Secure plates to frame with flat head countersunk screws.
- C. Set gratings loose in drainage trenches or over pits unless shown anchored.

**3.4 FRAMES FOR LEAD LINED DOORS**

- A. Secure jamb angle clips and plates, at top and bottom with two, 3/8 inch expansion bolts to concrete.
- B. Secure 6 x 3-1/2 x 1/2 inch angle to steel framing for anchorage when expansion bolts to concrete is not possible.
- C. Secure clips by welding to steel.
- D. At interstitial spaces, anchor jamb angles as shown.

### **3.5 DOOR FRAMES**

- A. Secure clip angles at bottom of frames to concrete slab with expansion bolts as shown.
- B. Level and plumb frame; brace in position required.
- C. At masonry, set frames in walls so anchors are built-in as the work progresses unless shown otherwise.
- D. Set frames in formwork for frames cast into concrete.
- E. Where frames are set in prepared openings, bolt to wall with spacers and expansion bolts.

### **3.6 OTHER FRAMES**

- A. Set frame flush with surface unless shown otherwise.
- B. Anchor frames at ends and not over 18 inches on centers unless shown otherwise.
- C. Set in formwork before concrete is placed.

### **3.7 GUARDS**

- A. Steel Angle Corner Guards:
  - 1. Build into masonry as the work progress.
  - 2. Set into formwork before concrete is placed.
  - 3. Set angles flush with edge of opening and finish floor or wall or as shown.
  - 4. At existing construction fasten angle and filler piece to adjoining construction with 5/8 inch diameter by 3 inch long expansion bolts 18 inches on center.
  - 5. Install Guard Angles at Edges of Trench Stairwell Openings in Slab Dock Leveler Overhead Doors where shown.
- B. Channel Guard at Top Edge of Concrete Platforms:
  - 1. Install in formwork before concrete is placed.
  - 2. Set channel flush with top of the platform.
- C. Wheel Guards:
  - 1. Set flanges of wheel guard at least 2 inches into pavement.
  - 2. Anchor to walls as shown, expansion bolt if not shown.

### **3.8 GRATINGS**

- A. Set grating flush with finish floor; top of curb, or areaway wall. Set frame so that horizontal leg of angle frame is flush with face of wall except when frame is installed on face of wall.
- B. Set frame in formwork before concrete is placed.
- C. Where grating terminates at a wall bolt frame to concrete or masonry with expansion bolts unless shown otherwise.
- D. Secure removable supporting members in place with stainless steel bolts.
- E. Bolt gratings to supports.

### **3.9 SHELF ANGLES**

- A. Anchor shelf angles with 3/4 inch bolts unless shown otherwise in adjustable malleable iron inserts, set level at elevation shown.
- B. Provide expansion space at end of members.

### **3.10 PLATE DOOR SILL**

- A. Install after roofing base flashing and counter flashing work is completed.
- B. Set in sealant and bolt to curb.

### **3.11 LADDERS**

- A. Anchor ladders to walls and floors with expansion bolts through turned lugs or angle clips or brackets.
- B. In elevator pits, set ladders to clear all elevator equipment where shown on the drawings.
  - 1. Where ladders are interrupted by division beams, anchor ladders to beams by welding, and to floors with expansion bolts.
  - 2. Where ladders are adjacent to division beams, anchor ladders to beams with bent steel plates, and to floor with expansion bolts.
- C. Ladder Rungs:
  - 1. Set ladder rungs into formwork before concrete is placed. Build ladder rungs into masonry as the work progresses.
  - 2. Set step portion of rung 6 inches from wall.
  - 3. Space rungs approximately 12 inches on centers.
  - 4. Where only one rung is required, locate it 16 inches above the floor.

### **3.12 RAILINGS**

- A. Steel Posts:
  - 1. Secure fixed posts to concrete with expansion bolts through flanged fittings except where sleeves are shown with pourable grout.
  - 2. Install sleeves in concrete formwork.
  - 3. Set post in sleeve and pour grout to surface. Apply beveled bead of urethane sealant at perimeter of post or under flange fitting on exterior posts.
  - 4. Secure removable posts to concrete with either machine screws through flanged fittings which are secured to inverted flanges embedded in and set flush with finished floor, or set posts in close fitting pipe sleeves without grout.
  - 5. Secure sliding flanged fittings to posts at base with set screws.
  - 6. Secure fixed flanged fittings to concrete with expansion bolts.
  - 7. Secure posts to steel with welds.
- B. Aluminum Railing, Stainless Steel Railing, and Ornamental Railing Posts:
  - 1. Install pipe sleeves in concrete formwork.

2. Set posts in sleeve and pour grout to surface on exterior locations and to within 1/4 inch of surface for interior locations except to where posts are required to be removable.
3. Apply beveled bead of urethane sealant over sleeve at post perimeter for exterior posts and flush with surface for interior posts.

C. Anchor to Walls:

1. Anchor rails to concrete or solid masonry with machine screws through flanged fitting to steel plate.
  - a. Anchor steel plate to concrete or solid masonry with expansion bolts.
  - b. Anchor steel plate to hollow masonry with toggle bolts.
2. Anchor flanged fitting with toggle bolt to steel support in frame walls.

D. Removable Rails:

1. Rest rails in brackets at each end and secure to bracket with stainless steel bolts and nuts where part of a continuous railing.
2. Rest rail posts in sleeves where not part of a continuous railing. Do not grout posts.

E. Gates:

1. Hang gate to swing as shown.
2. Bolt gate hinges to jamb post with clamp on or through bolts.

F. Chains:

1. Eye bolt chains to pipe posts.
2. Eye bolt anchoring at walls.
  - a. Expansion bolt to concrete or solid masonry.
  - b. Toggle bolt to hollow masonry of frame wall installed support.

G. Handrails:

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

**3.13 CATWALK AND PLATFORMS**

- A. Expansion bolt members to concrete unless shown otherwise.
- B. Bolt or weld structural components together including ladders and stairs to support system.
- C. Weld railings to structural framing.
- D. Bolt or weld walk surface to structural framing.
- E. Smooth field welds and spot prime damaged prime paint surface.

- F. Fasten removable members with stainless steel fasteners.

### **3.14 SIDEWALK DOOR, TRAP DOORS, AND FRAMES**

- A. Set frame flush with finished concrete slab or curb.
- B. Secure well linings to structure with expansion bolts unless shown otherwise.
- C. Bolt ceiling hatch to well lining angle brace and to angle iron frames near corners and 12 inches on centers with not less than 3/8 inch roundhead machine screws.
- D. Coordinate sidewalk door drain connections with plumbing work.

### **3.15 SCREENED ACCESS DOOR**

- A. Set frame in opening so that clearance at jambs is equal and secure with expansion bolts.
- B. Use shims at bolts to prevent deformation of frame members in prepared openings.
- C. Set frame in mortar bed and build in anchors as the masonry work progresses.
- D. Grout jambs solid with mortar.
- E. Secure insect screen to inside of door with stainless steel fasteners on doors in exterior walls.

### **3.16 STEEL COMPONENTS FOR MILLWORK ITEMS**

Coordinate and deliver to Millwork fabricator for assembly where millwork items are secured to metal fabrications.

### **3.17 CLEAN AND ADJUSTING**

- A. Adjust movable parts including hardware to operate as designed without binding or deformation of the members centered in the opening or frame and, where applicable, contact surfaces fit tight and even without forcing or warping the components.
- B. Clean after installation exposed prefinished and plated items and items fabricated from stainless steel, aluminum and copper alloys, as recommended by the metal manufacture and protected from damage until completion of the project.

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**SECTION 09 00 00**  
**WATER STORAGE TANK PAINTING**

**PART 1 GENERAL**

**1.1 Description**

- A. Work under this section consists of surface preparation, shop or field priming and painting necessary to complete work.
- B. Use coating systems specified in this section to finish all water tank components, unless otherwise indicated. Without restricting volume or generality, work to be performed under this section may include, but is not limited to:
  - 1. Exterior steel
  - 2. Interior steel
  - 3. Piping, hangers, and supports

**1.2 References**

- A. ASTM - American Society for Testing and Materials
- B. ASTM D16 Terminology Relating to Paint, Varnish, Lacquer, and Related Products
- C. ASTM D3359 Test Method for Measuring Adhesion by Tape Test
- D. ASTM D4263 Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
- E. ASTM D4541 Test Method for Pull Off Strength of Coatings Using Portable Adhesion-Testers
- F. ASTM D1005 Test for determining dry film thickness
- G. ASTM D4417 Test for determining surface profile
- H. SSPC - The Society for Protective Coatings
- I. SSPC-SP1 Specification for Solvent Cleaning
- J. SSPC-SP2 Specification for Hand Tool Cleaning
- K. SSPC-SP3 Specification for Power Tool Cleaning
- L. SSPC-SP5 Specification for White Metal Blast Cleaning
- M. SSPC-SP6 Specification for Commercial Blast Cleaning
- N. SSPC-SP7 Specification for Brush-Off Blast Cleaning
- O. SSPC-SP10 Specification for Near White Metal Blast Cleaning
- P. SSPC-SP11 Specification for Power Tool Cleaning to Bare Metal
- Q. SSPC-SP15 Specification for Commercial Power Tool Cleaning

- R. SSPC-PA1 Painting Application Specification
- S. SSPC-PA2 Measurement of Dry Paint Thickness with Magnetic Gages
- T. SSPC-SP12 Surface Preparation ... by High and Ultra-High Pressure
- U. SSPC-TU11 Inspection of Fluorescent Coating Systems

### 1.3 Definitions

- A. The term *PAINT* shall in a general sense have reference to zinc primers, acrylic, polyurethane and epoxy type coatings.
- B. DRY FILM THICKNESS (DFT): Thickness, measured in mils (1/1000 inch), of a coat of paint in cured state.

### 1.4 Submittals

- A. Product Data:
  - 1. Submit manufacturer's literature describing products to be provided, giving manufacturer's name, product name, and product line number for each material.
  - 2. Submit technical data sheets for each coating, giving descriptive data, curing times, mixing, thinning, and application requirements.
  - 3. Submit color charts showing manufacturer's full range of standard colors.
- B. Quality Assurance Submittals:
  - 1. Certificates:
    - a. Provide manufacturer's certification that products to be used comply with specified requirements and are suitable for intended application.
    - b. Submit listing of not less than 5 of applicator's most recent applications representing similar scope and complexity to Project requirements. List shall include information as follows:
      - i) Project name and address
      - ii) Name of owner
      - iii) Name of contractor
      - iv) Name of engineer
      - v) Date of completion
  - 2. Manufacturer's Instructions:
    - a. Submit manufacturer's installation procedures, if not on product data sheets, which shall be basis for accepting or rejecting actual installation procedures.

### 1.5 Quality Assurance

- A. Qualifications:



1. Applicator shall be trained in application techniques and procedures of coating materials and shall demonstrate a minimum of 5 years successful experience in such application.
    - a. Maintain, throughout duration of application, a crew of painters who are fully qualified.
  2. Single Source Responsibility:
    - a. PAINT shall be of a single manufacturer.
    - b. Secondary materials, which are produced or are specifically recommended by coating system manufacturer, may be used.
- B. Pre-Installation Meeting:
1. Schedule a meeting to be held on-site before field application of coating systems begins.
  2. Meeting shall be attended by Contractor, Owner's representative, Engineer, Coating Applicators, and Manufacturer's representative.
  3. Topics to be discussed at meeting shall include:
    - a. A review of Contract Documents and deviations or differences to be resolved.
    - b. Environmental conditions, surface conditions, surface preparation, application procedures, and protection following application.
    - c. Which areas on-site will be available for use as storage and working areas.
  4. Prepare and submit, to parties in attendance, a written report of pre-installation meeting. Report shall be submitted within 5 days following meeting.

#### **1.6 Delivery And Storage**

- A. Packing and Shipping:
1. Deliver products in manufacturer's original unopened containers. Each container shall have manufacturer's label, intact and legible.
  2. Include on label for each container:
    - a. Manufacturer's name
    - b. Type of paint
    - c. Manufacturer's stock number
    - d. Color name and number
    - e. Instructions for thinning, where applicable
- B. Storage and Protection:
1. Store materials in a designated protected area in accordance with Product Information instructions.

#### **1.7 Project Conditions**

- A. Environmental Requirements:
  - 1. Apply coating materials per manufacturer's printed data sheet instructions:
    - a. Refer to specific product data sheets for minimum surface temperature requirements. Surface temperatures shall be at least 5 degrees F above dew point and in a rising mode.
    - b. Provide for proper ventilation using explosion proof equipment. Allow to operate during the complete cure cycle of the coating
    - c. Adequate illumination shall be provided using explosion proof lights and equipment.
    - d. Atmosphere shall be free of airborne dust.

## **PART 2 PRODUCTS**

### **2.1 Acceptable Manufacturers**

- A. This specification lists products manufactured by The Sherwin Williams Company, Protective & Marine Division. Materials specified are cited as minimum standard of quality that will be acceptable.
- B. Materials specified shall not preclude consideration of equivalent materials. Equivalent materials shall be submitted to Engineer for consideration and shall be made at least ten (10) days prior to the date of bids.
  - 1. Requests for substitution shall include evidence of satisfactory past performance on water tanks.
  - 2. Substitutions will not be considered that change the number of coats, do not meet specified total dry film thickness.
  - 3. Coating system performance information, supplied by an ISO-certified laboratory, may be required prior to acceptance.
  - 4. Contractor shall state in the bid the amount of deduct to use equivalent materials to those specified.
  - 5. NSF International or UL Classified Water Quality must certify paints for interior wet applications for potable water contact in accordance with ANSI/NSF 61.
  - 6. For Composite Elevated Tanks (CET's), a system is available to coat the concrete pedestal. See Section 2.02a below.

### **2.2 COATING MATERIALS**

#### **NEW CONSTRUCTION - STEEL WATER STORAGE TANK**

**Tank Exterior - AWWA D102 Outside Coating System #4  
(Zinc/Urethane/Fluorourethane):**

Shop Surface Preparation: Remove all visible oil, dirt and other soluble contaminants in accordance with SSPC-SP1. All exterior surfaces shall be Commercial Blast Cleaned, removing all existing paint, rust, dirt, mill scale and foreign matter by the recommended methods outlined in The Society for Protective Coatings specification SSPC-SP6 (NACE No. 3).

Preconstruction Primer Option: Immediately after abrasive blasting and before any rusting occurs, apply one coat of Sherwin Williams Zinc Clad Ultra PCP at a dry film thickness of 0.6 to 0.8 mils.

Shop Prime Coat: Immediately after blasting and before any rusting occurs, apply one coat of Sherwin Williams Corothane I Galvapak Zinc Two Pack Zinc Primer (B65G10/B69D210) primer to all bare steel surfaces. This coating shall be applied at a dry film thickness of 2.5 to 3.5 mils.

Field Surface Preparation: Remove all oil, grease, soil, dirt and other soluble contaminants in accordance with SSPC-SP1. Weld slag, weld spatter, rough edges and sharp edges of weld seams shall be ground smooth. All rusted, abraded and unpainted areas shall be Commercial Blast Cleaned, removing all existing paint, rust, dirt, mill scale and foreign matter by the recommended methods outlined in The Society for Protective Coatings specification SSPC-SP6 (NACE No. 3).

Field Stripe Coat: Immediately after blasting and before any rusting occurs, apply one coat of Sherwin Williams Corothane I Galvapak Two Pack Zinc Primer (B65G10/B69D210) primer to all bare steel surfaces. The coating shall be applied at a dry film thickness of 2.5 to 3.5 mils.

Intermediate Coat: Apply one complete coat of Sherwin Williams Acrolon 218 HS (B65 Series) at a dry film thickness of 2.0 to 4.0 mils.

Finish Coat: Apply one complete coat of Sherwin Williams FluoroKem (B65-550 Series) at a dry film thickness of 2.0 to 3.0 mils. The Engineer/Owner shall select color.

Logo: Apply one complete coat of Sherwin Williams FluoroKem (B65-550 Series) at a dry film thickness of 2.0 to 3.0 mils.

**Tank Interior (Dry) - AWWA D102 Outside Coating System #6  
(Zinc/Epoxy/Polyurethane):**

Shop Surface Preparation: Remove all visible oil, grease, soil, dirt and other soluble contaminants in accordance with SSPC-SP1. The surface shall be be Commercial Blast Cleaned, removing all existing paint, rust, dirt, mill scale and foreign matter by the recommended methods outlined in The Society for Protective Coatings specification SSPC-SP6 (NACE No. 3).

Preconstruction Primer Option: Immediately after abrasive blasting and before any rusting occurs, apply one coat of Sherwin Williams Zinc Clad Ultra PCP at a dry film thickness of 0.6 to 0.8 mils.

Shop Prime Coat: Immediately after abrasive blasting and before any rusting occurs; apply one coat of Sherwin Williams Corothane I Galvapak

Two Pack Zinc Primer (B65G10/B69D210) at a dry film thickness of 2.5 to 3.5 mils.

Field Surface Preparation: Remove all oil, grease, soil, dirt and other soluble contaminants in accordance with SSPC-SP1. Weld slag, weld spatter, rough edges and sharp edges of weld seams shall be ground smooth. All rusted, abraded and unpainted areas shall be Commercial Blast Cleaned, removing all existing paint, rust, dirt, mill scale and foreign matter by the recommended methods outlined in The Society for Protective Coatings specification SSPC-SP6 (NACE No. 3).

Field Stripe Coat: Immediately after blasting and before any rusting occurs, apply one coat of Sherwin Williams Corothane I Galvapac Two Pack Zinc Primer

(B65G10/B69D210) primer to all bare steel surfaces. The coating shall be applied at a dry film thickness of 2.5 to 3.5 mils.

Field Intermediate Coat: Apply one complete coat of Sherwin Williams Macropoxy 646 Fast Cure Epoxy (B58-600 series) at a dry film thickness of 3.0 to 4.0 mils. To achieve complete finish coat coverage, the intermediate coat color should be noticeably different than the specified finish coat color. When feasible, the field intermediate coat should be in the same finish coat color family (blue, beige, gray, etc.) with a difference in light reflectance value of about 10%.

Field Finish Coat: apply one complete coat of Sherwin Williams Acrolon 218 HS or Hi-Solids Polyurethane (B65 Series) at a dry film thickness of 2.0 to 3.0 mils. Certain finish coat colors may require two coats depending upon the method of application and color of the intermediate coat. Color shall be selected by the Engineer/Owner.

Logo: Apply one complete coat of Sherwin Williams Acrolon 218 HS, Hi-Solids Polyurethane at a dry film thickness of 3.0 to 5.0 mils. For deep/ultradeep colors and/or accent stripes or designs, apply one coat of or FluoroKem (B65 Series) at a dry film thickness of 2.0 to 3.0 mils.

**Tank Interior (Wet) - AWWA D102 Inside Coating System #3 (100% solids Epoxy) with OAP**

**Option:**

***High film thickness / Edge retention in one coat / Rapid Return-to-Service***

Shop Surface Preparation: Remove all visible oil, grease, soil, dirt and other soluble contaminants in accordance with SSPC-SP1. The entire surface shall be Near White Blast Cleaned by the recommended methods outlined in The Society for Protective Coatings Specification SSPC-SP10 (NACE No. 2).

Preconstruction Primer Option: Immediately after abrasive blasting and before any rusting occurs, apply one coat of Sherwin Williams Zinc Clad Ultra PCP at a dry film thickness of 0.6 to 0.8 mils.

(Optional) Shop Prime Coat: Immediately after blasting and before any rusting occurs, apply one coat of Sherwin Williams Copoxy Shop Primer (62Y110/B62V110) or Corothane I Galvapac Series at a dry film thickness of 2.0 to 2.5 mils.

Finish Coat: Immediately after blasting and before any rusting occurs, apply one coat of Sherwin Williams Sherplate PW Epoxy with OAP (B62 Series) to all bare surfaces. Opti-Check pigment technology is recommended for rapid holiday detection with a safe ASTM E5201 light. This coating shall be applied at a dry film thickness of 20.0 to 25.0 mils.

### **2.3 PIT FILLING**

Pits, if any, shall be addressed by back-rolling or pit filling to produce a holiday free coating. Shallow pits, (typically up to 25% of steel thickness) can be made holiday free by back rolling the coating after it has been spray applied. Deeper pits shall be filled with a pit filler, such as Steel Seam FT 910 to eliminate holidays.

### **2.4 ACCESSORIES**

- A. Coating Application Accessories:
  - 1. Provide application accessories as indicated in coating manufacturer's application instructions, including but not limited to cleaning agents, etching agents, cleaning cloths, sanding materials, and clean-up materials.
  - 2. Material not specifically identified, but needed for proper application shall be of a quality not less than specified products.

- 2.5 MIXING Instructions:** Specific product mixing and thinning instructions are to be found in the manufacturer's printed data sheets.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Site Verification of Conditions:
  - 1. Examine areas and conditions under which application of coating systems shall be performed for conditions that will adversely affect execution, permanence, or quality of coating system application.
  - 2. Correct conditions detrimental to timely and proper execution of Work.
  - 3. Do not proceed until unsatisfactory conditions have been corrected.
  - 4. Commencement of installation constitutes acceptance of conditions and responsibility for satisfactory performance.

**3.2 CONTAINMENT AND COLLECTION OF REMOVED COATINGS, SANDBLAST MATERIAL, AND DEBRIS**

- A. Exterior sandblasting and coating removal activities must include a complete tank (100%) containment system. When enclosure methods are practiced, the Contractor shall strictly comply to USEPA, PADOH, OSHA Standards in respect to workman's and environmental safety. Proper ventilation shall be required to maintain a safe working environment. The enclosure shall be constructed to encapsulate the removed paint coatings, abrasives, debris, and all other materials generated during tank surface preparation operations in order to reduce emissions of the material into the environment to within current standards of the Federal Clean Air Act and National Air Quality Standards. Partial containment to contain the immediate work area only will not be approved.
- B. The Contractor's containment system shall be designed by a licensed professional engineer. The design of the containment system shall be submitted to the Engineer for review prior to installation. Containment shall fully enclose the tank with impermeable tarpaulins, or solid panels, supported by scaffolding, framing and/or cables. All joints shall be double overlapped and sealed and entryways shall be sealed and have a vestibule area to prevent duct emissions during entrance and exit. Negative airflow shall be provided via mechanical ventilation with exhaust air processed through a duct collector or bag house. The top of containment may be left open for air inlet providing the containment extends above the work area to prevent unacceptable emissions. Minimum acceptable downdraft and/or crossdraft air velocity is 1 MPH across the work area.
- C. The containment system must be capable of withstanding winds up to 30 MPH. Structural analysis of existing tank and foundation shall be included in the containment system design and may require lowering or dismantlement of containment system at wind velocities above 30 MPH. This determination shall be the responsibility of the Contractors Professional Engineer and shall be coordinated with the Engineer.
- D. Containment system must be designed such that it can be detached, lowered, dismantled, etc. in 1 hour or less for the protection of the tank and containment system.
- E. The base of the containment and any other areas outside containment subject to abrasive fallout shall be covered with impermeable tarpaulins or panels to facilitate cleanup of abrasive blasting residuals without release into the soil.
- F. The use of the tank appurtenances such as handrails, vents, walkways, overflow piping, drip angles, painter's rails, etc. and adjacent structures shall not be permitted to support the containment system.
- G. Components of the containment support system, which will be attached directly to the tank structure by welding, shall be fabricated from structural materials conforming to the Standard

Specification for Elevated Steel Water Tanks, Standpipes and Reservoirs of the American Water Works Association (AWWA D100). Material certifications are to be furnished with the containment design submittal.

- H. Welded attachments are to be made by welders certified to the requirements of AWWA D100 and AWS-D1. Welding and removal of attachments shall be sequenced with the interior painting operation so as not to damage interior coatings. Material thickness of all attachment points shall be determined by ultrasonic thickness measurement prior to making the attachment. These measurements are to be checked against thickness values used in the containment design calculations.
- I. All attachments must be removed unless otherwise approved by the Engineer. Removal shall be by grinding or other approved methods. Thickness of remaining base metal at attachment points shall be determined by ultrasonic thickness measurement and compared to initial values. No reduction of basemetal is allowed and the maximum increase in thickness shall be 1/8-inch and shall be free of rough edges, cracks, porosity, slag or other metallurgical defects.
- J. All material removed from the tank surface shall be collected in an approved manner. Temporary on site storage shall also be in accordance with all applicable laws for a hazardous waste. The Contractor shall make certain all residuals and debris are collected at least once per 8 hour work period and at the end of each work day and shall prevent the removed coating material, debris and any solutions from leaching into the ground.
- K. The Contractor shall be responsible for conducting TCLP (Toxicity Characteristic Leaching Procedure) tests, using a certified laboratory, on collected samples of material in order to determine if the waste is hazardous or non-hazardous, and if it is to be handled, stored, identified, secured and protected as a hazardous material. Collection containers shall be provided by the Contractor and shall be approved by the PADEP, PADOT, and other applicable Federal, State and Local regulators for storage, transportation and disposal.
- L. Dilution of collected coating material and debris at any time is prohibited.

### **3.3 MONITORING THE ENVIRONMENT**

- A. If required by State or local Laws and Regulations the Contractor shall furnish PM-10 ambient air monitors and/or total suspended particulate (TSP) monitors at required locations. The requirements of 4 CFR 50.6 for particulate matter (PM-10) and 40 CFR 50.12 for TSP shall apply unless local laws or regulations impose more stringent requirements.
- B. Monitoring of containment system deficiency shall be performed by the Owner, Engineer or Engineer's Consultant through the observation of visible emissions in accordance with 40 CFR 60, Appendix A, Method 22. Visible emissions are permitted from the

containment system at the frequency and durations specified below provided the emissions do not extend beyond the Owner's property line.

- C. The discharge of abrasive blasting residuals or any paint removal debris into a storm drain system, sanitary sewer, stream, river, brook creek, etc. or other body of water is prohibited. The Contractor shall take this into consideration when alternative coating removal methods involving the use of water or other liquids are being proposed.
- D. If tests and/or inspections reveal that the Contractor's containment system is failing to meet requirements of Laws and Regulations or the efficiency levels specified, the Contractor shall immediately modify, augment or otherwise the containment system or alter his method of abrasive blasting operation, such that these requirements are met. All costs for modifications, adjustments, improvements, etc. shall be borne by the Contractor.
- E. Owner or Engineer's approval of Contractor's proposed containment system in no way guarantees its compliance with the requirements of this section.

### **3.4 PREPARATION**

- A. Protection:
  - 1. Take precautionary measures to prevent fire hazards and spontaneous combustion. Remove empty containers from site at completion of each days work.
  - 2. Provide drop cloths, shields, and other protective equipment.
  - 3. Protect elements surrounding work from damage or disfiguration.
  - 4. As Work proceeds, promptly remove spilled, splashed, or splattered materials from surfaces. Leave storage area neat and clean at all times.
- B. **Surface Preparation:**
  - 1. General Requirements:
    - a. Prior to application of paint, surfaces shall be prepared to receive specified paintings system in compliance with these specifications.
    - b. Surfaces to be coated shall be clean, dry and free from dust and any foreign matter that might adversely affect adhesion or appearance.
  - 2. Ferrous Metal Surfaces:
    - a. For shop primed surfaces feather edges to make touch-up areas inconspicuous. Field welds and touch-ups shall be prepared to conform to original surface preparation standards.
    - b. Shop applied prime coatings which are damaged during transportation, construction or installation shall be thoroughly cleaned and touched up in field. Use



- repair procedures which insure complete protection of adjacent primer
- c. For surfaces not shop primed, surfaces shall be cleaned in compliance with specifications of The Society for Protective Coatings as indicated.
- 3. Galvanized Steel Surfaces:
  - a. Solvent clean metal to remove contamination and oils in compliance with SSPC-SP1.
  - b. Brush blast to abrade the surface.

### 3.5 APPLICATION

- A. General Requirements:
  - 1. Apply coating systems in compliance with manufacturer's instructions and using application method best suited for obtaining full, uniform coverage and hide of surfaces to be coated.
    - a. Work shall be implemented in compliance with applicable sections of AWWA D102 latest revisions.
  - 2. Apply primer, intermediate, and finish coats to comply with wet and dry film thicknesses and spreading rates for each type of material as recommended by manufacturer and in accordance with SSPC-PA2.
  - 3. Number of coats specified shall be minimum number acceptable. Apply additional coats as needed to provide a smooth, even application.
    - a. Closely adhere to re-coat times recommended by manufacturer. Allow each coat to dry thoroughly before applying next coat. Provide adequate ventilation for tank interior to carry off solvents during drying phase.
  - 4. Employ only application equipment that is clean, properly adjusted, and in good working order, and of type recommended by coating manufacturer.
  - 5. After surface preparation, spot primer on interior weld seams shall be brush applied.
- B. Thinning requirements for specified products are to be found in the paint manufacturer's printed data sheets and are to be strictly followed.
- C. Curing, Disinfection and Filling of Tank:
  - 1. Provide adequate ventilation for proper drying and curing of paint on interior surfaces and which will remove solvent vapors. For solvented coatings, provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with AWWA D102-2011, Section A.7.6. Forced air ventilation shall be maintained for a minimum of four (4) days following interior coating application to assist in the curing process.
  - 2. Following final application, tank shall not be disinfected or filled until coating system is fully cured.

3. Refer to applicable product data sheet(s) for dry time/temperature requirements. Disinfection (if specified) shall be in compliance with AWWA C652, or as instructed by Engineer.
- D. Interface with Other Work:
  1. Allow a minimum of seven days curing time after application of final coat to tank interior before flushing, disinfecting or filling with water.

### **3.6 REPAIR/RESTORATION**

- A. At completion of Work, touch-up and restore finishes where damaged.
- B. Defects in Finished Surfaces:
  1. When stain, dirt, or undercoats show through final coat, correct defects and cover with additional coats until coating is of uniform finish, color, appearance and coverage.
- C. Touch-up of minor damage shall be acceptable where result is not visibly different from surrounding surfaces. Where result is visibly different, either in color, sheen, or texture, recoat entire surface.

### **3.7 FIELD QUALITY CONTROL**

- A. Inspector's Services:
  1. Documents:
    - a. Review Contract Documents and applicable sections of referenced standards.
  2. Field Painting Inspection:
    - a. Verify cleaning operations to surfaces are to condition specified.
    - b. Verify conformance of paint to specification.
    - c. Check for thickness of each coating, final thickness and holidays.
    - d. Check touch-up for final finish.
    - e. Contractor will have both wet and dry film gauges onsite for inspector's use.
  3. Reports:
    - a. Submit written progress reports describing inspections made and showing action taken to correct non-conforming work. Report uncorrected deviations from Contract Documents.
- B. Manufacturer's Service:
  1. A representative of the paint manufacturer shall be available to provide on-site technical assistance, and guidance for application of the paint system as needed.

### **3.8 PROTECTION**

- A. Protect painted areas against damage until paint system is fully cured.

**3.9 ONE YEAR ANNIVERSARY INSPECTION**

- A. Owner shall set a date for a one year inspection.
- B. Inspection will be attended by an owner's representative, engineer, and painting contractor.
- C. Any deficiencies in the coatings system will be repaired at the contractor's expense.

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**SECTION 22 05 01**  
**MEASUREMENT AND CONTROL INSTRUMENTATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The Contractor shall provide all labor, material and equipment required to furnish, install, test, calibrate, place into satisfactory operation and guarantee measurement and control instrumentation equipment, complete with the necessary appurtenances and spare parts as described herein and as shown on the Contract Drawings.
- B. This section and related sections include field mounted instruments, local control panels and the distributed control system.
- C. It is not the intent of these specifications to enumerate, nor the intent of the Contract Drawings to illustrate, each and every required device. However, the Contractor is to carefully review the instrumentation drawings and specifications, undertake pre-bid discussions with the various manufacturers of equipment to be installed in this project and make all such inquiries as may be needed to determine the intent of this section of the specifications prior to preparing and submitting his bid price. The intent is to provide, under this Contract, a complete instrumentation and control systems that fully achieves the functions outlined on the Drawings and in these Specifications.

**1.2 RELATED WORK**

- A. Section 22 05 02, MEASUREMENT CONTROL AND INSTRUMENTATION - FUNCTIONAL DESCRIPTIONS
- B. Section 22 05 03, MEASUREMENT CONTROL AND INSTRUMENTATION - ELECTRONIC WIRING AND CABLE
- C. Section 22 05 04, INSTRUMENTS
- D. Section 22 05 05, INSTRUMENTATION AND CONTROL BOXES, PANELS, AND CONTROL CENTERS
- E. Section 22 05 06, RECORDERS
- F. Section 22 12 16, FACILITY ELEVATED, POTABLE-WATER STORAGE TANKS
- G. Division 26, ELECTRICAL

**1.3 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications
  - 1. There shall be a single supplier (systems integrator) who shall have overall responsibility for furnishing instruments, assembling and furnishing control panels, preparing shop drawings and O&M submittals, providing distributed control system hardware, programming and software, providing field start-up, testing, and calibration services, providing instructional services, and

providing quarterly calibration services for one year after project acceptance.

2. In order for an integrator to be considered acceptable, the following minimum qualifications must be demonstrated:
  - a. The integrator shall have a minimum of 5 years experience in water treatment plant instrumentation and control systems.
  - b. The integrator shall have a minimum of 2 successfully completed installations of similar scope and magnitude.
  - c. At least one (1) full-time employee providing field service shall be based at a location no more than 100 miles from the project site.

B. Acceptable Systems Integration Contractors.

1. Not Applicable

C. Uniformity of Manufacturers

1. Wherever possible, instrumentation equipment shall be of uniform manufacture. The Contractor shall take all reasonable steps possible to insure maximum uniformity and keep the number of manufacturers involved to an absolute minimum consistent with equipment selections made in this Specification.

#### **1.4 SUBMITTALS**

A. Shop Drawings and Product Data

1. As part of the requirements of this section of the specifications, the Contractor shall provide complete shop drawings and descriptive literature for the total Control System (CS) package for the Engineer's review. No fabrication, programming, or installation of any CS equipment shall take place without such review. No partial shop drawing submittals will be accepted.
2. The Contractor shall furnish the required reviewed instrumentation drawings, wiring diagrams and other related data to those subcontractors requiring such information to insure the timely and proper installation of this equipment.
3. Shop drawings for the distributed control system shall be submitted in accordance with the requirements of the General Requirements of these Specifications. Shop drawings for the distributed control system shall include, as a minimum, the following
  - a. Diagram of the distributed control system architecture. The

diagram shall show all hardware and communication components of the distributed control system. This drawing shall also identify Ethernet addresses, device addresses and normal operational settings for all DIP switches in the system.

- b. Specification sheets of all hardware and software. Complete model numbers shall be provided for review and approval.
- c. Internal wiring diagrams for each panel, including wire and terminal numbers, component layout drawings, and field device identifications.
- d. Interconnection wiring diagrams and process and instrumentation diagrams (loop diagrams) in accordance with ISA S5.4 Instrument Loop Diagrams, Illustration 7.4, latest revision, showing all field and panel-mounted equipment and terminal identification. Use the same component identification as shown on the Contract Drawings.
- e. External point-to-point wiring diagrams from control panel terminal strips to motor control centers and all process equipment control panels. Diagrams shall include the control panel number, wire numbers and terminal numbers.
- f. List of all inputs and outputs for each programmable logic controller.
- g. List of all reports and a sample of each report.
- h. Diagram of all graphic display screens. The diagram shall depict all graphic display screens and show their relationship to each other.
- i. Calculations for sizing of uninterruptable power supply (battery backup power supply) systems.
- j. Software logic flow diagrams for all programming, fully coordinated with Functional Descriptions presented in Section 13401.

B. As-Built Wiring Drawings

- 1. Prior to the start of Reliability Testing, seven (7) copies of the complete and accurate as-built wiring diagrams and drawings shall be provided to the engineer.

C. Control System Operation and Maintenance Instructions

- 1. Manufacturer's Operation and Maintenance Manuals (O&M's) shall be submitted in accordance with the requirements of the General

Requirements section of these Specifications. O&M's shall include, as a minimum, the following:

- a. Installation, operation, calibration, ISA-S20 specification and maintenance instructions for all field instruments. Field instrument manuals shall also include exploded view of the instruments with parts lists.
- b. Complete instruction manuals for all hardware and software provided.
- c. Display listing which shall include a list of all operator terminal displays generated for the project. A sample of each graphic display shall be included.
- d. I/O listing which shall include a list of all programmable logic controller inputs and outputs. I/O listing shall be broken down by PLC number and shall be provided with the software ID.
- e. Report listing which shall include a name of each report generated for the project. A sample of each report shall be provided.
- f. Configuration listing for each PLC and data concentrator, which shall describe the programming used to configure the device, along with the actual listings of the programming used. At a minimum, include the following: listings of the configuration and the data base of each PLC, and data concentrator including cross reference tables; listings of the configuration of each operator's device, including hierarchical display assignments and trend assignments.
- g. Operator's Manual shall contain all information required by the operator to perform all functions in the execution of his duties. At a minimum, include the following:
  - i. A detailed Table of Contents
  - ii. Emergency procedures.
  - iii. All software housekeeping or caretaking operations such as changing date and time, point calibration, point activation, point deactivation, etc.
  - iv. Software procedures that are beneficial to the operator to determine that the system is functioning properly.
  - v. Computer and printer operating instructions and software manuals.
  - vi. Procedures for historical record-keeping of all process data and reports.
  - vii. Hardware and software fault indicators.
  - viii. One complete backup set of all software and databases furnished by the CS System supplier in magnetic form.
  - ix. One on-site-verified and demonstrated test of all backup software on storage media (CD-ROM).

2. The distributed control system integrator shall place the Owner on a users mailing list to receive notices of hardware and software updates and revisions to documentation.
3. Operation and Maintenance Manuals (O&M's) shall be provided in bound and labeled sets. A complete index shall be provided with each volume. No loose items will be acceptable as part of the Control System Operation and Maintenance Manuals.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

##### **A. Protection of Equipment:**

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. Such replacement shall be at no additional cost to the Government.
3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

##### **B. Cleanliness of Piping and Equipment Systems:**

1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC), latest edition. All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.



## **1.6 APPLICABLE PUBLICATIONS**

Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC articles as applicable.

UL Compliance: Comply with applicable requirements of UL Standard.

FM Compliance: Comply with applicable Factory Mutual Standards.

EIA Compliance: Comply with applicable requirements of Electronic Industries Association Standards.

ISA Compliance: Comply with applicable requirements of The Instrument Society of America

## **PART 2 - PRODUCTS**

### **2.1 FACTORY-ASSEMBLED PRODUCTS**

- A. Not required this contract. Modifications to the existing RTU, PLC programming and HMI programming will be done in the field.

### **2.2 COMPATIBILITY OF RELATED EQUIPMENT**

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Field wiring shall be installed as shown on the schematics and in accordance with Division 16 - ELECTRICAL, to obtain a completely functional control system.
- B. Equipment shall be installed as shown on the Drawings and in accordance with the approved shop drawings and equipment manufacturer's installation instructions.
- C. Equipment shall be mounted in locations where it will be readily accessible for servicing.

### **3.1 INSTALLATION FIELD START-UP, TESTING AND INSTRUCTIONAL SERVICES FOR THE \** **DISTRIBUTED CONTROL SYSTEM**

- 1. Functional Acceptance Tests

- a. After the installation of all field instrumentation, process equipment and CS, the CS supplier and Contractor shall be responsible to demonstrate that the process equipment, field instrumentation and CS are fully functional and the operation complies with the specified performance requirements.
  - b. Functional acceptance tests shall be demonstrated to the Engineer on a component, loop, and individual input/output basis. It is the intent of the tests to prove that all field inputs and outputs have been properly integrated into the CS. In addition, the tests must prove that all software logic, alarms, report generation, etc., are functioning properly.
  - c. Prior to the performance of the functional acceptance tests, the CS supplier shall submit to the Engineer, for approval, a listing of all tests that will be performed.
  - d. In addition, the CS supplier shall also submit a sample copy of a functional acceptance test sign-off form for approval. Each completed functional acceptance test form shall include the following minimum information:
    - i. Specification page and loop identification number or system function demonstrated.
    - ii. Description of function or loop and test procedure used to demonstrate it.
    - iii. Space for comments regarding the test and if a retest is required.
    - iv. Space for sign-off by the Engineer and Contractor.
    - v. Space for date of test.
  - e. After receipt of approval by the Engineer of the functional acceptance tests, procedures and forms, a schedule for performing the tests shall be submitted.
2. Reliability Testing
- a. Upon completion and acceptance of all functional acceptance tests and the completion of Operator Training, the Control System Supplier shall be responsible for successful completion of a Reliability Testing.
  - b. The objective of the Reliability Testing is to demonstrate that the complete Control System is capable of operating in a reliable manner on a continuous basis.
  - c. The Reliability Test period shall not be less than 30 days. During the test period, the Control System, including all field instruments, shall operate with no more than 24 hours of cumulative downtime. Downtime will include failures of field instruments, PLC's, OIT, printers, servers, computers,

workstations, communications components, and any other equipment furnished in conjunction with the Control System.

- d. The Reliability Test shall be performed under normal facility operating conditions. The Engineer shall be formally notified one week prior to the proposed commencement of the reliability acceptance test. The test starting date and time shall be determined by the Engineer.
- e. The test results shall be documented by the System Integrator. The System Integrator shall maintain a log during the performance of the test. The log will be the minimum required documentation for the test and shall have entries for the following:
  - i. Test start date and time.
  - ii. Date and time of any failure, along with failure description and remedial action. Also included shall be the date and time when system operation was restored and the cumulative downtime since the start of the test.
  - iii. Test completion date and time.
- f. All log entries shall be signed by the System Supplier and Engineer.

### 3. Training

- a. The System Supplier shall provide formal on-site instruction to the Owner's personnel on the operation and maintenance of the CS. A complete training schedule complete with syllabus and course handouts for each session shall be submitted to the engineer at least 10 working days before the first scheduled session.
- b. After starting any of the training courses, conduct the course during normal eight hour working days until the conclusion of the course. The instructor for each course shall be assigned to it full time, and shall not perform other duties which will interrupt instruction during this period. The training courses shall not begin until after each major portion of the CS has successfully completed Factory and Functional Testing. Training shall be conducted prior to the start of the Reliability Testing.
- c. Initially, one classroom style training session for up to twenty (20) people per session shall be conducted. The session shall be a minimum of four (4) hours duration. The material presented shall include the following:
  - 1. System diagnostics and component replacement procedures.
  - 2. Log-on, log-off, and security protection features.
  - 3. Power failure and power restoration procedures.
  - 4. Data-base management and report generation.
  - 5. Process monitoring and control.

6. Setpoint and timer manipulation.
  7. Software operations.
  8. Hardware operations.
  9. Provide all other instruction required for the Owner's personnel to be able to fully operate the facility.
- d. Provide hands-on training at the operator interface and PLC level. Hands on training shall be a minimum of four (4) hours in duration. Training will include review of graphics, reports, alarms, and control functions.
- e. After acceptance of the entire project, the CS supplier shall provide one (1) site visit for on-the-job training during the one (1) year project maintenance period. The CS supplier shall submit a schedule for approval by the Engineer. On-the-job training shall include a review of all aspects of the control system, with special emphasis given to any problem areas found by the operators during the first six months of operation. The CS supplier shall also check all hardware and software for errors and answer any operator's inquiries regarding the CS operation. Time spent repairing equipment which has failed shall not be considered as meeting the requirements of this section of the Specifications. A written report of each training session shall be submitted in quadruplicate to the Engineer.

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**SECTION 22 05 02**  
**MEASUREMENT AND CONTROL INSTRUMENTATION - FUNCTIONAL DESCRIPTION**

**PART 1 - GENERAL**

NOT USED - refer to Specification 220501 for General Requirements.

**PART 2 - PRODUCTS**

**2.1 DESCRIPTIONS**

A. Overview

The Contractor's scope includes, but is not limited to the following work.

1. Provide and install a new gage pressure type level transmitter at the tank location.
  2. Provide, install and interconnect a new tank level control panel in the Boiler House.
  3. Provide install and program a new controller in the Boiler House. Controller must be compatible with facility's existing Johnson Controls Metasys building management system.
  4. Integrate the new controller into the existing Metasys building management system. Provide and install all network cables and devices and modify, as required, the existing equipment and programming to communicate with the new controller and display tank level and alarms.
  5. Provide, install wire and program a new paperless recorder in the Boiler House.
- B. Tank level will be measured with a gage pressure transmitter located in the tank enclosure. The transmitter will be connected to the inlet/outlet piping near the bottom of the tank; however, it will be mounted a grade in the tank enclosure. The transmitter calibration shall adjust for the mounting elevation and shall provide a 4-mAdc output when tank level is at the bottom of the tank and 20 mAdc when the tank is full.
- C. The tank level transmitter will be powered from a 24 Vdc supply in the tank level control panel to be mounted in the boiler house. The control panel will include a signal splitter that will share the tank level signal with a chart recorder.
- D. The paperless recorder will monitor tank level and will provide dry contact high level and low level alarm outputs.

- E. The tank level control panel will monitor high and low level alarms from the chart recorder and will provide hardwired relay logic to energize indicating lights on the panel door for tank level high low and normal. In addition, the panel will provide high, low and normal level dry contact outputs to the controller.
- F. The tank level control panel will include an alarm buzzer and a silence pushbutton. The buzzer and alarm light will be energized when a high or low alarm first occurs. The buzzer will be de-energized when the silence pushbutton is actuated. The buzzer will reset when the alarm condition clears.
- G. The new controller will be integrated into the existing Johnson Controls Metasys building management system. The contractor shall modify the existing communications network to include the new controller. Existing operator interface workstations will be modified to display tank level and annunciate level alarms.
- H. The tank will be equipped with an intrusion alarm on the entrance door to the tank base and a position switch on the tank access hatch. Both signals will be monitored by the controller and will be used to generate intrusion alarms.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

Not Used

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**SECTION 22 05 03**  
**MEASUREMENT AND CONTROL INSTRUMENTATION MATERIALS AND METHODS**  
**ELECTRONIC WIRE AND CABLE**

**PART 1 - GENERAL**

NOT USED - refer to Specification 220501 for General Requirements.

**PART 2 - PRODUCTS**

**2.0     INSTRUMENTATION CABLE**

- A. Electronic transmission shall be via stranded, shielded, twisted conductors of not less than 18 AWG conductor wire. All termination points shall have terminal lugs. Instruments and panels shall be grounded to the nearest plant equipment ground. Shielded cable shall have the shield grounded at one point for each loop; preferably at the point of origin. Signal wires shall not be run in conduit containing wire used for any other purpose.
- B. Signal cable (4-20 mA) shall be 18-gauge twisted shielded single pair tinned copper stranded conductors with Teflon insulation. The pair shall have a minimum lay of 2 inches per twist. The shield shall be aluminum-polyester with a 20 AWG stranded tinned copper drain wire and an overall Teflon jacket rated at 300 volts. Color code shall be red and black. Cable shall be suitable for plenum, conduit and submerged service.
- C. Fiber optic cable shall have gel filled loose tube, single jacket, armored construction for installation in hostile industrial environments. Fiber optic cable shall be suitable for installation in conduit above and below grade, aerial lashed or direct buried. Fiber optic cable shall be oil, chemical, moisture and UV sunlight resistant. Unless otherwise indicated, fiber optic cable shall be 62.5/125 micron Multimode type with a minimum of 12 fiber conductors.
- D. Ethernet cables shall be Category-6 cables and shall have four, AWG 23, solid bare copper, twisted pairs with overall shield. Conductors shall have Fluoropolymer insulation. The outer shield shall be aluminum foil-polyester tape. The outer jacket shall be flame retardant, low smoke polyvinyl chloride. Cable shall be plenum rated. Cables shall be RJ-45 compatible.

**PART 3 - EXECUTION**

**3.0     GENERAL WIRING METHODS**

Signal wires shall not be run in conduit or tray carrying wiring used for any other purpose. All signal wire runs shall be continuous from point to point. Where signal wires must be joined, only terminal strips shall be used. Instruments shall be installed and grounded per the manufacturer's installation instructions.

Each control panel or panelboard circuit providing power to instruments or other devices shall have its own neutral wire run from the instrument or device back to the neutral bus in the panelboard. The use of a common neutral wire for devices on different circuits is prohibited.

Terminal blocks shall be used for interconnection. All terminals are to be clearly numbered in a manner that permits reading of terminal designations without interference from terminated wires. Field terminals carrying 120 VAC shall be fused and equipped with a rocker-type switch to isolate the panel from 120 VAC for servicing.

A switch shall be provided to disconnect the entire panel from the power supply(s). All wiring shall be color coded according to its service. All wires are to be tagged at both ends with tag numbers shown on approved submittal drawings. Wiring shall be stranded copper conductor. Panel wiring shall be protected with the appropriate fuse or circuit breaker. Minimum wire size shall be AWG # 16.

Conduit entrances to all panels and devices shall be sealed, after wire installation, to prevent condensation and moisture from entering the panel or device. Conduit entrances into field mounted panels and devices shall not be made from the top unless specifically approved by the equipment manufacturer and Engineer.

Each instrument is to have engraved on the manufacturer's data plate, or on a separate tag, the instrument number shown on the Drawings.

All wiring and piping shall be horizontal or vertical runs and groups of wires to common points shall be neatly harnessed and adequately supported. Wiring shall be run to numbered terminal blocks mounted on the inside of the enclosure for connections to power and external equipment.

All resistance amplifiers, isolation units, power supplies and transformers required to achieve satisfactory operation shall be included as part of this section of the Specifications.

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**SECTION 22 05 04**  
**INSTRUMENTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The Contractor shall provide all labor, material and equipment required to furnish, install, test, calibrate, place into satisfactory operation and guarantee instruments, complete with the necessary appurtenances and spare parts as described herein and as shown on the Contract Drawings.
- B. This section includes field mounted instruments. It is not the intent of these specifications to enumerate, nor the intent of the Contract Drawings to illustrate, each and every required device. However, the Contractor is to carefully review the instrumentation drawings and specifications, undertake pre-bid discussions with the various manufacturers of equipment to be installed in this project and make all such inquiries as may be needed to determine the intent of this section of the specifications prior to preparing and submitting his bid price. The System Supplier, under this Contract, is required to provide a complete instrumentation and control system that fully achieves the functions outlined on the Drawings and in these Specifications.

**1.2 RELATED WORK**

- A. Section 22 05 01, MEASUREMENT CONTROL AND INSTRUMENTATION
- B. Section 22 05 02, MEASUREMENT CONTROL AND INSTRUMENTATION - FUNCTIONAL DESCRIPTIONS
- C. Section 22 05 03, MEASUREMENT CONTROL AND INSTRUMENTATION - ELECTRONIC WIRING AND CABLE
- D. Section 22 05 05, INSTRUMENTATION AND CONTROL BOXES, PANELS, AND CONTROL CENTERS
- E. Section 22 05 06, RECORDERS
- F. Section 22 12 16, FACILITY ELEVATED, POTABLE-WATER STORAGE TANKS
- G. Division 26, ELECTRICAL

**1.3 QUALITY ASSURANCE**

REFER TO SECTION 22 05 01, Section 1.3

**1.4 AS-BUILT WIRING DRAWINGS**

Prior to the start of Reliability Testing, seven (7) copies of the complete and accurate as-built wiring diagrams and drawings shall be provided to the engineer.

**1.5 CONTROL SYSTEM OPERATION AND MAINTENANCE INSTRUCTIONS**

Manufacturer's Operation and Maintenance Manuals (O&M's) shall be submitted in accordance with the requirements of the General Requirements section of these Specifications. O&M's shall include, as a minimum, the following:

- a. Installation, operation, calibration, ISA-S20 specification and maintenance instructions for all field instruments. Field instrument manuals shall also include exploded view of the instruments with parts lists.
  - b. Complete instruction manuals for all hardware and software provided.
  - c. Display listing which shall include a list of all operator terminal displays generated for the project. A sample of each graphic display shall be included.
  - d. I/O listing which shall include a list of all programmable logic controller inputs and outputs. I/O listing shall be broken down by PLC number and shall be provided with the software ID.
  - e. Report listing which shall include a name of each report generated for the project. A sample of each report shall be provided.
  - f. Configuration listing for each PLC and data concentrator, which shall describe the programming used to configure the device, along with the actual listings of the programming used. At a minimum, include the following: listings of the configuration and the data base of each PLC, and data concentrator including cross reference tables; listings of the configuration of each operator's device, including hierarchical display assignments and trend assignments.
  - g. Operator's Manual shall contain all information required by the operator to perform all functions in the execution of his duties. At a minimum, include the following:
    - i. A detailed Table of Contents
    - ii. Emergency procedures.
    - iii. All software housekeeping or caretaking operations such as changing date and time, point calibration, point activation, point deactivation, etc.
    - iv. Software procedures that are beneficial to the operator to determine that the system is functioning properly.
    - v. Computer and printer operating instructions and software manuals.
    - vi. Procedures for historical record-keeping of all process data and reports.
    - vii. Hardware and software fault indicators.
    - viii. One complete backup set of all software and databases furnished by the CS System supplier in magnetic form.
    - ix. One on-site-verified and demonstrated test of all backup software on storage media (CD-ROM).
2. The distributed control system integrator shall place the Owner on a users mailing list to receive notices of hardware and software updates and revisions to documentation.

3. Operation and Maintenance Manuals (O&M's) shall be provided in bound and labeled sets. A complete index shall be provided with each volume. No loose items will be acceptable as part of the Control System Operation and Maintenance Manuals.

## 1.6 APPLICABLE PUBLICATIONS

Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC articles as applicable.

UL Compliance: Comply with applicable requirements of UL Standard.

EIA Compliance: Comply with applicable requirements of Electronic Industries Association Standards.

ISA Compliance: Comply with applicable requirements of The Instrument Society of America

## PART 2 - PRODUCTS

### 2.1 PRESSURE GAUGES

- A. The Contractor shall furnish and install gauges where shown on the Drawings and as specified herein and elsewhere in the Specifications. Each gauge shall be a minimum of 4-1/2" diameter black glass-filled polyester construction. The gauges shall be constructed with an over pressure stop or a decoupler mechanism to protect gauge from shutoff damage; external zero reset adjustment shall be standard. All gauges shall have glycerin oil filled cases; accuracy shall be  $\pm 0.5\%$  of the entire range; connection shall be 1/4" NPT male.
- B. All gauges shall be first-line high quality, suitable for operation in continuous and uninterrupted service with a minimum of maintenance, adjustment or repair. Snubbers, petcocks, nipples and other appurtenances shall be furnished and installed with the gauges.
- C. Gauges for use in raw, filtered, and finished water and for air service shall have stainless steel bellows or Bourdon tubes. Unless otherwise shown on the Contract Drawings or specified elsewhere in these Specifications, diaphragm seals are not required for gauges in raw, filtered and finished water or air service.
- D. Gauges used in services other than raw, settled, filtered, and finished water and air shall be equipped with diaphragm seals. They shall have brass or bronze bellows or Bourdon tubes.

- E. Contractor shall be responsible for installing, calibrating, and testing of all gauges.
- F. All gauges shall be equipped with isolation valves and drain connections in accordance with details on the Contract Drawings. Gauges on the suction or discharge piping of pumps, blowers, and compressors shall be equipped with pressure snubbers.
- G. The contractor shall supply pressure indicators in accordance with the following table and the Plans and Specifications.

TAG	DESCRIPTION	CALIBRATION
PI-XXX	With Tank Level Transmitter	0-100 PSI

- H. The pressure gauges shall be provided with corrosion resistant tags engraved with the instrument tag number indicated in this document or the Plans and Specifications. Tags shall be 316 stainless steel, 1 inch by 3 inches, with 1/4 inch letters.

## 2.2 GAUGE PRESSURE TRANSMITTERS

- A. Transmitters for pressure application shall sense a process pressure and transmit a 4-20 mAdc signal directly proportional to pressure.
- B. The transmitters shall be 2-wire devices. The measuring range shall be fully adjustable throughout the span limit. Accuracy, including the combined effects of linearity, hysteresis, and repeatability, shall be  $\pm 0.25\%$  of calibrated span.
- C. The diaphragm and connection materials shall be 316 S.S. The capsule fill fluid shall be silicone oil.
- D. The topworks section shall consist of one compartment. The electronics shall be completely potted to protect against moisture. Connections between the electronics and the field terminal strip shall be hermetically sealed.
- E. The transmitter mechanism shall be protected by a gasketed weatherproof enclosure providing environmental protection of NEMA 4 construction.
- F. Pressure indicating transmitters shall be provided with a 3-1/2 digit LCD display scaled to the engineering units of the measured process variable.
- G. The transmitters shall have a full 2-year warranty.
- H. The transmitters shall be provided with stainless steel block and bleed valves and pipe mounting brackets.
- I. Specifications:

Accuracy: 0.065 % Accuracy, 100-1 Turndown, 5 Year Stability

Measurement: Gage Pressure  
Range: As Required for Service  
Diaphragm: 316 SST  
Process Conn :Coplanar Flange, 316 SST, 1/4 Inch-18 NPT  
Drain and Vent: 316 SST  
Output: 4-20 mAdc with Hart communications  
Housing: PlantWeb Housing, Aluminum, 1/2"-14 NPT Conduit  
Mounting: Coplanar flange Bracket, SST, 2 Inch Pipe and Panel  
Meter: Integral Mount Digital LCD

J. Gage pressure transmitters shall be supplied with 316 Stainless Steel block and bleed valves.

K. The contractor shall supply gage pressure transmitters in accordance with the following table and the Plans and Specifications.

<u>TAG</u>	<u>DESCRIPTION</u>	<u>CALIBRATION</u>
LIT-300	Tank Level	0-40 FT

### 2.3 DOOR SWITCHES - INTRUSION ALARMS

A. Door switches shall be provided at all doorways.

B. Door switches shall actuate when the door is fully closed to indicate the open or closed status of the door.

C. The switch contact shall be a hermetically sealed reed switch with matching actuating magnet. Contact and magnets shall be in brushed anodized aluminum tube housing.

D. Contact shall be sealed in polyurethane potting compound. Contact shall be rated 0.5 A at 120 Volts AC.

E. **Note: The Contractor shall coordinate with the tank supplier to determine the manufacturer and model number of the tank enclosure door switch.**

F. The contractor shall supply door switches in accordance with the following table and the Plans and Specifications.

<u>TAG</u>	<u>DESCRIPTION</u>
ZS-xxx	Tank Enclosure Entrances

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

Field wiring shall be installed as shown on the schematics and in accordance with Division 16 - Electrical, to obtain a completely functional control system.

Equipment shall be installed as shown on the Drawings and in accordance with the approved shop drawings and equipment manufacturer's installation instructions.

Equipment shall be mounted in locations where it will be readily accessible for servicing.

#### **3.2 START-UP SERVICE**

The systems integrator shall provide field services for as many days as necessary to test, calibrate, troubleshoot, and place into satisfactory service the entire instrumentation system. Once the system is operational, the systems integrator shall provide a minimum of two days of on-site instruction and training services to the Owner's personnel.

The services of a qualified representative from each manufacturer shall be provided to inspect the completed equipment installation, make all adjustments necessary to place the system in trouble-free operation and instruct the operating personnel in the proper care and operation of the equipment furnished. Every instrument is to be calibrated to its manufacturer's stated accuracy. All necessary tools, test instruments or other devices required to perform a three point calibration for each instrument is to be provided by the manufacturer's representative. Field calibration shall be supervised by the project coordinator and witnessed by the Engineer or his representative. A minimum of two days advanced notice of such calibration shall be given to the Engineer.

The supervision of equipment start-up and the instruction of Owner personnel in operation of the instrumentation and controls shall be performed by factory-trained representatives of the equipment manufacturers. After the system is operating satisfactorily, the performance shall be demonstrated to the satisfaction of the Owner, who will be the judge of its acceptability.

Cost of providing manufacturers service representative for start-up and for training plant personnel shall be borne by the Contractor and is included in the Contract Price. No time or trip limitations shall be placed on these services.

### **3.3 CALIBRATION SERVICES DURING WARRANTY PERIOD**

During the first year of operation (starting from date of final acceptance), the systems integrator shall check and adjust as necessary the calibration and operation of all instrumentation at intervals of 90 days. These services shall be included in the Contractor's price bid for the various items and a written report of each inspection and calibration shall be submitted in quadruplicate to the Engineer.

- - - E N D - - -

**SECTION 22 05 05**  
**INSTRUMENTATION AND CONTROL BOXES, PANELS, AND CONTROL CENTERS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The Contractor shall provide all labor, material and equipment required to furnish, install, test, calibrate, place into satisfactory operation and guarantee equipment, complete with the necessary appurtenances and spare parts as described herein and as shown on the Contract Drawings.
- B. It is not the intent of these specifications to enumerate, nor the intent of the Contract Drawings to illustrate, each and every required device. However, the Contractor is to carefully review the instrumentation drawings and specifications, undertake pre-bid discussions with the various manufacturers of equipment to be installed in this project and make all such inquiries as may be needed to determine the intent of this section of the specifications prior to preparing and submitting his bid price. The System Supplier, under this Contract, is required to provide a complete instrumentation and control system that fully achieves the functions outlined on the Drawings and in these Specifications.

**1.2 RELATED WORK**

- A. Section 22 05 01, MEASUREMENT CONTROL AND INSTRUMENTATION
- B. Section 22 05 02, MEASUREMENT CONTROL AND INSTRUMENTATION - FUNCTIONAL DESCRIPTIONS
- C. Section 22 05 03, MEASUREMENT CONTROL AND INSTRUMENTATION - ELECTRONIC WIRING AND CABLE
- D. Section 22 05 04, INSTRUMENTS
- E. Section 22 05 06, RECORDERS
- F. Section 22 12 16, FACILITY ELEVATED, POTABLE-WATER STORAGE TANKS
- G. Division 26, ELECTRICAL

**1.3 QUALITY ASSURANCE**

Refer To Specification 22 05 01 - Section 1.3

**1.4 APPLICABLE PUBLICATIONS**

- A. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC articles as applicable.
- B. UL Compliance: Comply with applicable requirements of UL Standard.
- C. EIA Compliance: Comply with applicable requirements of Electronic Industries Association Standards.



- D. ISA Compliance: Comply with applicable requirements of The Instrument Society of America

### 1.5 AS-BUILT WIRING DIAGRAMS

- A. The Contractor shall furnish detailed wiring drawings for all instrument and control panels. These drawings shall show all control panel wiring, including point to point wiring, terminal numbers and wire numbers and all field wiring, including control panel terminals, field device terminal numbers and wire numbers. These drawings shall be coordinated with the as-built drawing submittals required under Division 16000, so that there is one final set of point-to-point field wiring diagrams which include all power, control, and instrumentation wiring. In addition to the external wiring, any changes made by the Contractor of internal wiring of any equipment, or any addition of components inside any enclosure furnished by the Contractor shall have "As Built" revisions to the original manufacturer's drawings detailing these additions or revisions. These shall include all wire numbers and terminals used.
- B. OPERATION AND MAINTENANCE MANUAL
1. Manufacturer's Operation and Maintenance Manuals (O&M's) shall be submitted in accordance with the requirements of the General Requirements section of these Specifications (Division 13400). O&M's shall include, as a minimum, the following:
    - a. Installation, operation, calibration, ISA-S20 specification and maintenance instructions for all instruments. Instrument manuals shall also include exploded view of the instruments with parts lists.
    - b. Complete instruction manuals for all hardware and software provided.
    - c. Display listing which shall include a list of all operator displays generated for each field instrument where applicable.
    - d. Configuration listing for each instrument, which shall describe any programming used to configure the device, along with the actual configuration values used.
    - e. The Operator's Manual shall contain all information required by the operator to perform all functions in the execution of his duties. At a minimum, include the following:
      - I. A detailed Table of Contents
      - II. Emergency procedures.
      - III. All software housekeeping or caretaking operations such as changing date and time, point calibration, point activation, point deactivation, etc.

- IV. Software procedures that are beneficial to the operator to determine that the system is functioning properly.
- V. Computer and printer operating instructions and software manuals.
- VI. Procedures for historical record-keeping of all process data and reports.
- VII. Hardware and software fault indicators.
- VIII. Operation and Maintenance Manuals (O&M's) shall be provided in bound and labeled sets. A complete index shall be provided with each volume.
- IX. No loose items will be acceptable as part of the Control System Operation and Maintenance Manuals.

## **PART 2 - PRODUCTS**

### **2.1 INSTRUMENT AND CONTROL PANELS**

#### **A. Construction**

1. All instrument and control panels shall have a UL sticker indicating that the panel meets the UL requirements for an industrial control panel.
2. Panels shall be manufactured from 14gauge sheet stainless steel, hand selected for finish and levelness. Frame shall be 3/16" angle iron. Construction shall be of the NEMA ratings shown on the Drawings. If ratings are not shown, panels shall be as follows:
  - a. In chemical rooms and in underground chambers - NEMA 4X
  - b. In other process areas containing pumps, piping, etc. NEMA-4.
  - c. In outdoor locations - NEMA-4.
  - d. In indoor areas containing no process equipment or piping - NEMA-12.
  - e. In hazardous areas (explosive hazard) - NEMA 7 for Class I, Division I
3. All NEMA 4X panels shall be manufactured of stainless steel. Fiberglass enclosures shall be used where required due to chemical compatibility with stainless steel and where designated on the Contract Drawings. Alternate materials shall not be acceptable.
4. The units shall be of all welded construction so that the units are completely enclosed and self-supporting. All seams and corners shall be welded and ground smooth. The front of the units shall be enclosed with full length flush pan type doors which are supported by continuous piano hinges and furnished with padlock hasp. All door locks are to be keyed alike. All cutouts shall be laid out in accordance with the best panel design standards and shall be ground smooth. The

enclosure door shall be provided with a document holder to hold wiring drawings and service information.

5. Interior stiffeners shall be furnished as required. Stiffener locations shall be determined by size and cutout arrangement.
6. Construction tolerances shall be  $+1/8$ " for height, width, and depth. The panel faces will have a maximum deviation of  $1/16$ " from a flat plane. The panels shall be provided with approved engraved white on black laminated bakelite nameplates, mounted with S.S. screws; adhesive backings are not acceptable. The exact wording of nameplates shall be submitted to the Engineer for approval prior to fabrication.
7. The panels shall be provided with an adequate quantity of terminal points plus at least 20% spares, to provide junction points for wiring being routed from other locations through the control panel to other panels or equipment. When panels contain power wiring (voltage greater than 120 vac), the main power disconnect shall be interlocked to prevent the panel door from being opened without opening the disconnect. The interlock shall be equipped with a screwdriver operable defeater. The internal layout of the panel shall separate power and control components. Where a panel is fed from multiple power sources it shall be divided into sections. Each section shall have its own door interlocked with its own main power disconnect. The sections shall be separated by metal barriers.
8. All conduit entrances into panels shall be made with threaded gasketed hubs. The use of lock nuts is not acceptable. The Contractor shall coordinate the location of conduit entrances with his suppliers in order to provide sufficient room for wire bending and allow for access to internal components.
9. Freestanding panels shall be mounted on 4" high concrete curbs. Pedestals for pedestal mounted panels shall be set on 1" of non-shrink grout. Freestanding and pedestal mounted panels shall be bolted to the floor with a minimum of four  $1/2$ " diameter stainless steel anchor bolts. Floor stands or pedestals shall be provided as needed to meet the specified instrument and device height requirements.
10. All field wiring which must be terminated inside the control panel enclosure, including all active and spare terminal points on all installed PLC I/O cards, shall be factory wired

to terminal blocks. Terminal blocks shall be furnished with at least 20 percent spare terminal points.

11. Panels shall be furnished complete with interposing relays, circuit breakers, fuses, terminal blocks, etc., as required, to provide a complete operational system. Interposing relay contacts shall be rated for 10A.
12. The interior of freestanding instrument panels shall be equipped with one (1) 40W fluorescent light fixture. The light fixture shall be operated by a switch located inside the panel. All instrument panels shall be provided with a utility GFI duplex receptacle.
13. The interior of the panels shall be equipped with subpanels for the mounting of wireways, rails, controllers, relays, timers, etc. Mounting of internal components shall not disturb or penetrate the exterior surface of the panels.
14. Each panel dimension shall be as shown on the Contract Drawings or as required to accommodate the equipment it contains, and approved by the Engineer.
15. Outline drawings including overall dimensions, schematic diagrams, point to point wiring diagrams and component layout drawings shall be reviewed by the Engineer before construction of units. Record point to point diagrams indicating wire size, color, number, etc. shall also be provided.
16. Paint, if required, shall be manufacturer's standard baked enamel finish. The finish shall be left in perfect condition following installation and acceptance and one quart of matching touch-up paint shall be furnished for each different color panel. Stainless steel panels shall not be painted. Enclosure finish shall include one (1) coat of rust inhibiting primer and one (1) coat of ANSI #61 gray polyester powder. The enclosure interior and back panel shall be painted white.

#### B. Panel Arrangement

1. Instruments and controls shall be mounted on the panels in functional groups as shown on the Contract Drawings. On panels not shown on the Contract Drawings, all instruments and devices shall be mounted in functional groups at an elevation between 30 and 66 inches above the finished floor.

2. Layout shall be subject to the approval of the Engineer. All instruments on panel faces shall be selected to match each other and shall present a pleasing coordinated view.

### C. Panel Wiring

1. Control wiring within the control panel shall be type THHN. Minimum wire size shall be AWG #16. Panel control wiring shall be color coded as follows:

a. 120 Vac Line (*L1)	Black
b. 120 Vac Neut (*L2)	White
c. 120 Vac Externally Sourced	Yellow
d. Other 120 Vvac	Red
e. Equipment Grounds	Green
f. Instrument Grounds	Green
g. 24 Vdc	Blue

2. All control wiring shall be stranded copper, Type MTW or THHN, single conductor wire, with 600 Volt insulation. Wires labeled \*L1 or \*L2 shall be AWG # 14 or as indicated on the Schematic Wiring Diagrams. Other control wiring shall be AWG # 16 or as indicated on the Schematic Wiring Diagrams. In all cases, wire size shall be in accordance with the National Electric Code based on the maximum current available.
3. All low-level signal wiring shall be 300 Volt, AWG # 18, stranded tinned copper, twisted pair, with shield. Conductor colors shall be Black and White or Red and Black.
4. All wire shall be identified, at each end, with the wire number indicated on the Schematic Wiring Diagrams. Pre-printed sleeve type wire markers shall be used.
5. Wiring to devices with screw terminals shall use insulated ring tongue lugs.
6. Panel wiring shall be run in plastic wire duct wherever practical.
7. Where applicable, wires shall be bundled with tie-wraps. Cord lacing is not acceptable.
8. Low-level signal wiring shall be run in separate ducts from 120 VAC control wiring. If signal wiring must cross control wiring, it shall cross at a 90-degree angle.

9. Panel wiring shall not interfere with routine maintenance. Sufficient slack shall be provided such that slide-out type equipment, including PLC I/O wiring arms, can be removed with wiring in place.
10. Field terminal blocks shall be mounted on High-Rise DIN Rails or two inch standoffs.
11. All jumpers shall be installed on the panel wiring side of the field terminal blocks.
12. All wiring shall be continuous. Wire splices are not acceptable.
13. Terminal blocks shall be provided as splice points for devices with pigtail leads and for signal wiring shield connections, if necessary.
14. A 1-inch by ¼-inch copper equipment ground bus shall be provided. The bus shall be electrically bonded to the panel steel. The ground bus shall include a ground lug sized to accept an external equipment grounding conductor.
15. A 1-inch by ¼-inch copper isolated ground bus shall be provided. Each signal cable shield shall be connected to this bus. The isolated ground bus shall be interconnected to the equipment ground bus at a single point.
  - a. p. Wiring to the interior light and utility outlet shall be run in separate metal conduit where practical. Flexible conduit is acceptable.

#### D. Electrical

1. All wiring between the equipment and the panels shall be furnished and installed by a qualified electrician as specified below and under Division 26. All electrical connections to terminals shall be made with wire lugs. All electrical connections within panels shall be terminated at interposing terminal boards, with all external connections properly identified for field connections. All wires are to be continuous from point to point. Wire nuts shall not be used for connections or to extend wire length.

2. All 120 volt devices located within the panel are to be fed from the 120 volt power feed to that panel. When control panels include a programmable logic controller, the PLC shall monitor the incoming 120 vac power. Loss of power shall be alarmed.
3. All 120 volt powered field instruments are to be fed from the control panel that monitors the instrument. If the panel includes a UPS or is fed from a common UPS, field instruments shall be supplied with UPS power. A circuit breaker shall be provided for the common field instrument power circuit. Individual instrument feeds shall be isolated with fusible switches.
4. If the panel includes a UPS or is fed from a common UPS, all 24 VDC power supplies are to be supplied with UPS power. A separate circuit breaker shall be provided for each supply.
5. All power sources (120 VAC or 24 VDC) leaving the control panel, such as dry contact interrogation voltage for PLC discrete inputs, shall be equipped with a fusible switch to isolate the individual circuits.
6. All 24 VDC 2-Wire and 3-Wire instrument loop power leaving the control panel shall be equipped with a fusible switch to isolate the individual signals.
7. One (1) duplex 120 Vac, 3-prong, GFCI type utility receptacle shall be provided within the enclosure for service equipment. The utility receptacle shall be fed from a 10 Amp circuit breaker. The utility receptacle shall not be fed from the UPS.
8. All equipment enclosures shall be well grounded to the nearest plant ground via a copper ground conductor.
  - a. All non-isolated AC and equipment grounds shall be hardwired, with individual conductors, to the non-isolated ground buss. It shall not be acceptable to connect ground conductors directly to the panel steel.
  - b. All isolated signal grounds shall be hardwired, with individual conductors, to the isolated ground buss. It shall not be acceptable to gang ground conductors together with a common connection to the ground bus.

9. All analog signal cables to and from instruments located outdoors, or in other buildings, shall be protected with surge suppressors.
10. All control signal cables to and from instruments located outdoors, or in other buildings, shall be protected with surge suppressors.
11. All control power cables to and from instruments located outdoors, or in other buildings, shall be protected with surge suppressors.

E. Identification

1. Instrument and electrical device nameplates, both interior and exterior shall be provided.
2. Panel face nameplates shall be engraved per the Nameplate Engraving List.
3. Panel face nameplates shall be 3/32 inch thick White and Black laminated Bakelite. Nameplates shall be 1 inch by 3 inches with chamfered edges, or as indicated on the Nameplate Engraving List.
4. Panel nameplates shall have Black letters on a White background. Engraving shall be all capitals, with 5/32 inch letter height and shall be centered on the nameplate.
5. Panel face nameplates shall be attached with stainless steel screws on NEMA 12 panels. Panel face nameplates shall be attached with "Scotch Mount" double-sided tape or epoxy cement on NEMA 4 and 4X panels.
6. Not in Contract
7. Interior nameplates shall be engraved per the Schematic Wiring Diagrams and the Layout and Details drawing(s).
8. Interior nameplates shall be approximately ½ inch by 1 inch, permanently engraved and attached with double-sided tape or epoxy cement. DYMO tape is not acceptable.
9. Interior nameplates shall have Black letters on a White background.

**2.2 TERMINAL BLOCKS**

- A. Terminal blocks shall be provided for interposing field terminations,



power wiring and grounding. Terminal blocks shall be provided with terminal strip labeling system, which shall include markers and holders.

### **2.3 FUSIBLE SWITCH BLOCKS**

- A. Fusible Switch blocks shall be provided for overload protection and circuit isolation. Fusible switch blocks may be used for field wiring termination. Fusible switch blocks shall have an LED blown fuse indicator.

### **2.4 PUSH-BUTTON CONTROL STATIONS**

- A. Pushbuttons shall be provided for control and other functions, as shown, specified or required. Push-buttons shall be of industrial oil/watertight construction with flush button and guard ring, rated NEMA 4.
- B. Where push-button control stations will be located outdoors, all materials of construction shall be ultraviolet resistant.

### **2.5 SELECTOR SWITCHES**

- A. Selector switches shall be provided for control and other functions, as shown, specified or required. Selector switches shall be of industrial oil/watertight construction.
- B. Where selector switches will be located outdoors, all materials of construction shall be ultraviolet resistant.

### **2.6 INDICATING LIGHTS**

- A. Indicating lights shall be provided for status indication, alarm and other functions, as shown, specified or required. Indicating lights shall be the industrial oiltight, "Push to Test", transformer type complete with lamp and appropriate color plastic lens. Lamps shall be grouped LED type.
- B. Where indicating lights will be located outdoors, all materials of construction shall be ultraviolet resistant.

### **2.7 GENERAL PURPOSE RELAYS**

- A. All relays shall be UL labeled, general purpose, industrial grade, with plug-in base, sealed clear polycarbonate cover and neon lamp to indicate that the coil is energized.

B. Relay-Specifications

1. Contact:
  - a. Rating 10 Amp Resistive, DPDT
  - b. HP  $\frac{1}{4}$  HP at 120 VAC
  - c. Material Gold Flashed Silver Button Mech.
  - d. Mech Life 50 million operations (AC)
  - e. Elec. Life 100,000 operations min. at rated resistive load
  - f. Max. Cycling Speed 10 operations per minute
2. Coil:
  - a. Nominal Voltage 12, 24 vDC or 120 VAC
  - b. Nominal Power 1.4 Volt-Amperes Max.
  - c. Power 2.55 Volt-Amperes
  - d. Temperature Rise 55° at nominal voltage
  - e. Duty Continuous
3. General:
  - a. Operating Time 20 milliseconds Release
  - b. Time 15 milliseconds
  - c. Insulation Resistance 1,000 megohms at 500 VDC
  - d. Dielectric Strength 1,000 VAC, RMS (50/60 HZ)
  - e. Range -45°C to 50°
  - f. Shock 20 G's, 11 + 1 ms,  $\frac{1}{2}$  sine wave
  - g. Vibration 6 G's, 10 to 55 HZ
  - h. Weight Approx. 1-1/2oz.
  - i. Size 1.374" x 1.070" x .815" (HxWxD)

- C. All relays shall be mounted with plug-in socket and retention clamp. No soldering is permitted. Relays with 120 VAC coils shall be series KRPA-N with round pin. Relays with other coil voltages shall be series KUMP-5 with straight blade bases.

## 2.8 DIGITAL TIME DELAY RELAYS

- A. Timing relay shall be UL labeled, solid state hybrid type with calibrated binary dip switches. Relays shall be plate mounted or plug-in type with retention clamp. Timing function and range shall be as required or as shown on the Contract Drawings.
- B. The relays shall house two LED indicator lamps. One lamp shall light while the relay is energized and the other shall light as

long as power is applied to the output relay. The relay shall reset when de-energized.

C. Digital Time Delay Relay-Specifications

1. Contact:
  - a. Rating 10 amp resistive at 120 VAC
  - b. Configuration DPDT
  - c. Mech. Life 10 million operations
  - d. Elect. Life 0.5 million operations
2. Control:
  - a. Voltage 12, 24, 120V
  - b. Power 3 VA
  - c. Frequency 50, 60 Hz or DC
3. General:
  - a. Setting Accuracy + 2%
  - b. Repeat Accuracy + 0.1%
  - c. Temperature Range 0 C to +55 C
4. Duty Cycle
  - a. Continuous
5. Timing Functions
  - a. On delay
  - b. Off delay
  - c. Interval
  - d. Single shot
  - e. Repeat Cycle
  - f. Programmable

**2.9 INTERPOSING RELAYS - USED WITH PLC I/O**

- A. Interposing relays shall be miniature industrial type engineered for applications requiring long life and reliable performance. Relays shall be plug-in type with mounting socket. Relays shall have LED type indication of energized/de-energized state.
- B. Relays shall have 24 VDC or 120 VAC coils; SPDT, DPDT or 3 PDT as required for the intended service. Contact rating shall be 10 amps resistive. Relays shall be RH series midget power general purpose relays.

## 2.10 SIGNAL SURGE VOLTAGE PROTECTORS

- A. The Contractor shall furnish and install surge protectors as specified herein and as shown on the Contract Drawings.
- B. Surge protectors shall consist of a base mounting element and a removable protection plug.
- C. Surge protection shall be provided for all analog and discrete signals to electronic control devices, as indicated on the Plans and Specifications and if the signals originate outdoors or in other buildings.

## 2.11 ETHERNET SURGE PROTECTORS

- A. The Contractor shall furnish and install surge protectors as specified herein and as shown on the Contract Drawings.
- B. The surge protectors shall be designed to protect 10/100BaseT Ethernet devices from voltage surges and lightning strikes. The surge protector shall utilize metal oxide varistors with a double network of ultra-fast diodes and silicon avalanche diodes.
- C. Surge protection shall be provided for all Ethernet devices, as indicated on the Plans and Specifications and if the Ethernet signals originate outdoors or in other buildings.

D. Specifications:

Technology:	MOVs with diodes
Usage:	10BaseT or 100BaseTx
Ports:	Two
Connectors:	RJ45
Surge Capacity:	1 kA / line
Clamp and rated:	10 V and 5 V
Max Frequency:	155 MHz
Operating Temperature:	-40 to 85 Deg C
Attenuation:	Better than -0.3 dB at 100 MHz
N.E.X.T.	Better than -43 dB at 100 MHz
Ratings:	UL 497B, EIA/TIA (TSB 40A)

## 2.12 UNINTERRUPTIBLE POWER SUPPLIES - ON-LINE INDUSTRIAL

- A. The uninterruptable power supply (UPS) shall be the Industrial On-Line type. The UPS shall consist of a rectifier, inverter, batteries and battery charger. Incoming utility power shall supply the UPS rectifier and battery charger. The inverter shall derive power from the rectifier and shall provide a sine wave output to the load. An integral bypass shall transfer inverter supply from the rectifier to the batteries upon a utility power failure.
- B. The UPS shall be rated to operate between 0 and 40 Deg C ambient temperature and humidity of 0 to 95 % non-condensing.
- C. Control panels containing programmable logic controllers or network components that require a power supply shall be powered by a packaged 120Vac input x 120Vac output uninterruptible power supply (UPS). The UPS shall provide AC power to all 120 VAC powered devices and controls and all 24 VDC power supplies in the event of a main power failure.
- D. The UPS shall be sized to provide 60 minutes of operating time under normal system loading. The UPS shall provide power to all 120 VAC devices within the panel and to field devices that are powered from the panel.
- E. The contractor shall provide calculations with the shop drawing submittal indicating the basis of model selection.
- F. Control panels shall be adequately sized to provide ample space to house the UPS within the panel. The UPS shall be supported in a rack or shelf within the control panel. The UPS shall not interfere with field wiring or block access to any panel devices. In no case shall the UPS be placed on top of the panel.

## **2.13 24 VDC POWER SUPPLIES**

- A. Regulated power supplies shall provide DC power for two wire instrumentation loops, process control transmitters, digital circuitry, and programmable logic controller systems. The power supplies shall be UL listed, single output, short circuit protected and encapsulated with screw terminals.
- B. Input voltage shall be 105 to 125 VAC, 47 to 420 Hz, single phase. Output voltage shall be 24 VDC with +0.1% load regulation at +0.05% line regulation and 1 mVRMS ripple. Output current shall

be 0.6 amps. No de-rating shall be required with an ambient operating temperature of  $-20^{\circ}\text{C}$  to  $+71^{\circ}\text{C}$ .

- C. The negative DC output terminal of the power modules shall be grounded to the isolated ground bus. Positive terminal grounding is not acceptable.

## **2.14 SIGNAL ISOLATOR/SPLITTER**

- A. The Contractor shall furnish and install signal isolator/splitters as specified herein and as shown on the Contract Drawings.
- B. The signal isolator/splitter shall be a four-wire type instrument. It shall provide 1500 Vrms isolation between input, output and power. Input (DC) load resistance shall be 50 Ohms. The unit shall be designed to operate between  $-40$  and  $85^{\circ}\text{C}$  with 0 to 95 percent humidity, non-condensing. Span and zero adjustments shall be accessible from the front panel. Span and zero shall be non-interactive.

## **2.15 STROBE LIGHTS**

- A. The strobe light shall provide 300,000 peak candela and shall operate on 120 VAC. The enclosure shall be NEMA 4X rated for indoor or outdoor use and shall be resistant to shock and vibration.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Wiring shall be installed as shown on the schematics or loop diagrams and in accordance with Division 26 - Electrical, to obtain a completely functional control system.
- B. Equipment shall be installed as shown on the Drawings and in accordance with the approved shop drawings and equipment manufacturer's installation instructions.
- C. Equipment shall be mounted in locations where it will be readily accessible for servicing.

## **3.2 START-UP SERVICE**

- A. The systems integrator shall provide field services for as many days as necessary to test, calibrate, troubleshoot, and place into satisfactory service the entire control system. Once the system is operational, the

systems integrator shall provide a minimum of two days of on-site instruction and training services to the Owner's personnel.

- B. The supervision of equipment start-up and the instruction of Owner personnel in operation of the instrumentation and controls shall be performed by factory-trained representatives of the equipment manufacturers. After the system is operating satisfactorily, the performance shall be demonstrated to the satisfaction of the Owner, who will be the judge of its acceptability.
- C. Cost of providing manufacturers service representative for start-up and for training plant personnel shall be borne by the Contractor and is included in the Contract Price. No time or trip limitations shall be placed on these services.

### **3.3 CALIBRATION SERVICES DURING WARRANTY PERIOD**

- A. During the first year of operation (starting from date of final acceptance), the systems integrator shall check and adjust as necessary the calibration and operation of all control instruments at intervals of 180 days. These services shall be included in the Contractor's price bid for the various items and a written report of each inspection and calibration shall be submitted in quadruplicate to the Engineer.

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**SECTION 22 05 06**  
**RECORDERS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The Contractor shall provide all labor, material and equipment required to furnish, install, test, calibrate, place into satisfactory operation and guarantee chart recorders, complete with the necessary appurtenances and spare parts as described herein and as shown on the Contract Drawings.

**1.2 RELATED WORK**

- A. Section 22 05 01, MEASUREMENT CONTROL AND INSTRUMENTATION
- B. Section 22 05 02, MEASUREMENT CONTROL AND INSTRUMENTATION - FUNCTIONAL DESCRIPTIONS
- C. Section 22 05 03, MEASUREMENT CONTROL AND INSTRUMENTATION - ELECTRONIC WIRING AND CABLE
- D. Section 22 05 04, INSTRUMENTS
- E. Section 22 05 05, INSTRUMENTATION AND CONTROL BOXES, PANELS, AND CONTROL CENTERS
- F. Section 22 12 16, FACILITY ELEVATED, POTABLE-WATER STORAGE TANKS
- G. Division 26, ELECTRICAL

**1.4 SUBMITTALS**

- A. As part of the requirements of this section of the specifications, the Contractor shall provide complete shop drawings and descriptive literature for the total instrument package for the A/E's review. No fabrication or installation of any instrument shall take place without such review.
- B. The Contractor shall furnish the required reviewed instrument drawings, wiring diagrams and other related data to those subcontractors requiring such information to insure the timely and proper installation of this equipment.
- C. Shop drawing submittals shall include, as a minimum, the following:
  - 1. Data sheets and descriptive literature for each instrument and device.
- D. After installation, the Contractor shall furnish detailed external wiring drawings for all instruments and controls. These drawings shall show all point to point wiring, the terminal numbers and wire numbers used on the external wires. These drawings shall be coordinated with the as-built drawing submittals, so that there is one final set of point-to-point field wiring diagrams which include all power, control,



and instrumentation wiring. In addition to the external wiring, any changes made by the Contractor of internal wiring of any equipment, or any addition of components inside any enclosure furnished by the Contractor shall have "As Built" revisions to the original manufacturer's drawings detailing these additions or revisions. These shall include all wire numbers and terminals used.

#### 1.6 APPLICABLE PUBLICATIONS

Electrical Code Compliance:	Comply with applicable local code requirements of the authority having jurisdiction and NEC articles as applicable.
UL Compliance:	Comply with applicable requirements of UL Standard.
EIA Compliance:	Comply with applicable requirements of Electronic Industries Association Standards.
ISA Compliance:	Comply with applicable requirements of The Instrument Society of America

### PART 2 - PRODUCTS

#### 2.1 PAPERLESS RECORDERS

- A. The Contractor shall provide paperless recorders as indicated on the Plans and Specification.
- B. Paperless recorders shall be configured either from the local display on the recorder or through a personal computer. The display shall provide a description of each input channel, the pen number and color assigned to that channel and the current value of the input in engineering units.
- C. The paperless recorder shall provide a means to upload stored data to a personal computer or permanent storage media. Data shall be available in a standard format that can be imported to Microsoft Excel.
- D. Scales shall be in engineering units with the ranges indicated in the Plans and Specifications.
- E. Recorders shall include dry contact relay outputs that can be programmed to generate high and low alarm signals based on a specific analog input signal.
- F. Specifications:
  - Housing: NEMA 12
  - Power: 120 vac
  - Analog Inputs: 4-20 mAdc
  - Analog Outputs: 4-20 mAdc - Qty: One for each input
  - Event Inputs: Dry Contact - Qty: (8) Eight

Relay Outputs: Dry Contact, 2 Amps at 250 vac - Qty: 3

Temperature: Operating: 0 to 50 Deg C

Humidity: 10 to 90 Percent

- G. The Contractor shall provide paperless recorders in accordance with the following table and/or the Plans and Specifications.

<i>TAG</i>	<i>DESCRIPTION</i>	<i>PEN No.</i>	<i>CHART RANGE</i>
LIR-XXX	Tank Level	1	0 to 40.0 Feet

- H. The paperless recorders shall be provided with corrosion resistant tags engraved with the instrument tag number indicated in this document or the Plans and Specifications. Tags shall be 316 stainless steel, 1 inch by 3 inches, with 1/4 inch letters.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Field wiring shall be installed as shown on the schematics and in accordance with Division 26 - ELECTRICAL, to obtain a completely functional control system.
- B. Piping for transmitters, gauges, analyzers, etc., shall be in accordance with Division 22.
- C. Equipment shall be installed as shown on the Drawings and in accordance with the approved shop drawings and equipment manufacturer's installation instructions.
- D. Equipment shall be mounted in locations where it will be readily accessible for servicing.

#### **3.2 START-UP SERVICE**

- A. The systems integrator shall provide field services for as many days as necessary to test, calibrate, troubleshoot, and place into satisfactory service the entire instrumentation system. Once the system is operational, the systems integrator shall provide a minimum of two days of on-site instruction and training services to the Corporation's personnel.
- B. The services of a qualified representative from each manufacturer shall be provided to inspect the completed equipment installation, make all adjustments necessary to place the system in trouble-free operation and instruct the operating personnel in the proper care and operation of the equipment furnished. Every instrument is to be calibrated to its manufacturer's stated accuracy. All necessary tools, test instruments or other devices required to perform a three point

calibration for each instrument are to be provided by the manufacturer's representative. Field calibration shall be supervised by the project coordinator and witnessed by the COR or his representative. A minimum of two days advanced notice of such calibration shall be given to the COR.

- C. The supervision of equipment start-up and the instruction of Corporation personnel in operation of the instrumentation and controls shall be performed by factory trained representatives of the equipment manufacturers. After the system is operating satisfactorily, the performance shall be demonstrated to the satisfaction of the Corporation, who will be the judge of its acceptability.
- D. Cost of providing manufacturers service representative for start-up and for training plant personnel shall be borne by the Contractor and is included in the Contract Price. No time or trip limitations shall be placed on these services.

### **3.3 CALIBRATION SERVICES DURING WARRANTY PERIOD**

- A. During the first year of operation (starting from date of final acceptance), the systems integrator shall check and adjust as necessary the calibration and operation of all instrumentation at intervals of 90 days. These services shall be included in the Contractor's price bid for the various items and a written report of each inspection and calibration shall be submitted in quadruplicate to the COR.

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**SECTION 22 05 11**  
**COMMON WORK RESULTS FOR PLUMBING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section shall apply to all sections of Division 22.
- B. Definitions:
  - 1. Exposed: Piping and equipment exposed to view in finished rooms.
  - 2. Option or optional: Contractor's choice of an alternate material or method.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 31 20 00, EARTH MOVING: Excavation and Backfill.
- E. Section 03 30 53, CAST-IN-PLACE CONCRETE: Concrete and Grout.
- F. Section 05 50 00, METAL FABRICATIONS.
- G. Section 09 00 00, WATER STORAGE TANK PAINTING.
- H. Section 22 12 16, FACILITY ELEVATED, POTABLE-WATER STORAGE TANKS
- I. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

**1.3 QUALITY ASSURANCE**

- A. Products Criteria:
  - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years.
  - 2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the

- project): pumps, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
  4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the Contracting Officers Technical Representative (COR).
  5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
  6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
  7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
  8. Asbestos products or equipment or materials containing asbestos shall not be used.
- B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
  2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
  3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.

4. All welds shall be stamped according to the provisions of the American Welding Society.
- C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- D. Execution (Installation, Construction) Quality:
  1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract drawings and specifications shall be referred to the COR for resolution. Written hard copies or computer files of manufacturer's installation instructions shall be provided to the COR at least two weeks prior to commencing installation of any item.
  2. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved.
- E. Guaranty: Warranty of Construction, FAR clause 52.246-21.
- F. Plumbing Systems: IPC, International Plumbing Code.

#### **1.4 SUBMITTALS**

- A. Submittals shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.
- C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

- E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Upon request by Government, lists of previous installations for selected items of equipment shall be provided. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
- G. Manufacturer's Literature and Data: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
  - 1. Electric motor data and variable speed drive data shall be submitted with the driven equipment.
  - 2. Equipment and materials identification.
  - 3. Fire stopping materials.
  - 4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
  - 5. Wall, floor, and ceiling plates.
- H. Coordination Drawings: Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping until layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.
  - 1. Mechanical equipment rooms.
  - 2. Interstitial space.
  - 3. Hangers, inserts, supports, and bracing.
  - 4. Pipe sleeves.
  - 5. Equipment penetrations of floors, walls, ceilings, or roofs.

I. Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
2. Listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided.
3. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

**1.5 DELIVERY, STORAGE AND HANDLING**

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. Such replacement shall be at no additional cost to the Government.
3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC), latest edition. All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.



4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below shall form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):  
Boiler and Pressure Vessel Code (BPVC):  
SEC IX-2007.....Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications.
- C. American Society for Testing and Materials (ASTM):  
A36/A36M-2008.....Standard Specification for Carbon Structural Steel  
A575-96 (R 2007).....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades R (2002)  
A992/A992M-06a.....Specification for Structural Steel Shapes  
E84-2005.....Standard Test Method for Surface Burning Characteristics of Building Materials  
E119-2008a.....Standard Test Methods for Fire Tests of Building Construction and Materials
- D. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:  
SP-58-02.....Pipe Hangers and Supports-Materials, Design and Manufacture  
SP 69-2003 (R 2004).....Pipe Hangers and Supports-Selection and Application
- E. National Electrical Manufacturers Association (NEMA):  
MG1-2003, Rev. 1-2007...Motors and Generators
- D. International Code Council, (ICC):  
IBC-06, (R 2007).....International Building Code  
IPC-06, (R 2007).....International Plumbing Code

#### **PART 2 - PRODUCTS**

##### **2.1 FACTORY-ASSEMBLED PRODUCTS**

- A. STANDARDIZATION OF COMPONENTS SHALL BE MAXIMIZED TO REDUCE SPARE PART requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
  2. Constituent parts that are alike shall be products of a single manufacturer.
  3. Components shall be compatible with each other and with the total assembly for intended service.
  4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, shall be the same make and model

## **2.2 COMPATIBILITY OF RELATED EQUIPMENT**

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

## **2.3 SAFETY GUARDS**

- A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 1/4-inch bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.
- B. All Equipment shall have moving parts protected from personal injury.

## **2.4 LIFTING ATTACHMENTS**

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

## **2.5 EQUIPMENT AND MATERIALS IDENTIFICATION**

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or shown in the maintenance manuals.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 3/16-inch high of brass with black-filled letters, or rigid black

plastic with white letters specified in Section 09 91 00, PAINTING shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, fans, etc. shall be identified.

- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 3/16-inch high riveted or bolted to the equipment.
- D. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
  - 1. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
  - 2. Valve tags: Engraved black filled numbers and letters not less than 1/2-inch high for number designation, and not less than 1/4-inch for service designation on 19 gage, 1-1/2 inches round brass disc, attached with brass "S" hook or brass chain.
  - 3. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 8-1/2 inches by 11 inches shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a punched 3-ring binder notebook. A copy of the valve list shall be mounted in picture frames for mounting to a wall.
  - 4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling.

## **2.6 GALVANIZED REPAIR COMPOUND**

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

## **2.7 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

- A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC), 2009. Submittals based on the International Building Code (IBC), 2009, or the following paragraphs of this Section shall be signed and sealed by a Professional Engineer currently licensed in the Commonwealth of Pennsylvania. The Support system of suspended equipment over 500 pounds shall be submitted for

approval of the COR in all cases. See these specifications for lateral force design requirements.

- B. Type Numbers Specified: MSS SP-58. For selection and application refer to MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.
- C. For Attachment to Concrete Construction:
  - 1. Concrete insert: Type 18, MSS SP-58.
  - 2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 4 inches thick when approved by the COR for each job condition.
  - 3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 4 inches thick when approved by the COR for each job condition.
- D. For Attachment to Steel Construction: MSS SP-58.
  - 1. Welded attachment: Type 22.
  - 2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 7/8-inch outside diameter.
- E. For Attachment to Wood Construction: Wood screws or lag bolts.
- F. 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 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- G. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-5/8 inches by 1-5/8 inches, No. 12 gage, designed to accept special spring held, hardened steel nuts. Trapeze hangers are not permitted for steam supply and condensate piping.
  - 1. Allowable hanger load: Manufacturers rating less 200 pounds.
  - 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 1/2-inch galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
- H. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11 PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate

shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.

1. General Types (MSS SP-58):

- a. Standard clevis hanger: Type 1; provide locknut.
- b. Riser clamps: Type 8.
- c. Wall brackets: Types 31, 32 or 33.
- d. Roller supports: Type 41, 43, 44 and 46.
- e. Saddle support: Type 36, 37 or 38.
- f. Turnbuckle: Types 13 or 15.
- g. U-bolt clamp: Type 24.
- h. Copper Tube:
  - 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with isolation tape to prevent electrolysis.
  - 2) For vertical runs use epoxy painted or plastic coated riser clamps.
  - 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
  - 4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
- i. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp. Spring Supports (Expansion and contraction of vertical piping):
  - 1) Movement up to 3/4-inch: Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
  - 2) Movement more than 3/4-inch: Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
- j. Spring hangers are required on all plumbing system pumps one horsepower and greater.

2. Plumbing Piping (Other Than General Types):

- a. Horizontal piping: Type 1, 5, 7, 9, and 10.
- b. Chrome plated piping: Chrome plated supports.

- c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
  - d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 18 gage minimum.
- I. Pre-insulated Calcium Silicate Shields:
- 1. Provide 360 degree water resistant high density 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 cold water shall have insulation that extends a minimum of one inch past the sheet metal.
    - b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To support the load, the shields shall have one or more of the following features: structural inserts 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.

## **2.10 PIPE PENETRATIONS**

- A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.
- B. Pipe penetration sleeve materials shall comply with all fire stopping requirements for each penetration.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
  - 1. For sleeves: Extend sleeve 1 inch above finished floor and provide sealant for watertight joint.
  - 2. For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
  - 3. For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

- C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of COR.
- D. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- E. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.
- F. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel Sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
- G. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.
- H. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 1 inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 1 inch in diameter. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

## **2.12 TOOLS AND LUBRICANTS**

- A. Furnish, and turn over to the COR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- D. Lubricants: A minimum of 1 quart of oil, and 1 pound of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

### **2.13 WALL, FLOOR AND CEILING PLATES**

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 3/32-inch for floor plates. For wall and ceiling plates, not less than 0.025-inch for up to 3 inch pipe, 0.035-inch for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

### **2.14 ASBESTOS**

Materials containing asbestos are not permitted.

## **PART 3 - EXECUTION**

### **3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING**

- A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.

Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.

- B. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.
- C. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.



- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Cutting Holes:
  - 1. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COR where working area space is limited.
  - 2. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
  - 3. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. Protection and Cleaning:
  - 1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.
  - 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- I. Concrete and Grout: Concrete and shrink compensating grout 3000 psi minimum, specified in Section 03 30 53, CAST-IN-PLACE CONCRETE shall be used for all pad or floor mounted equipment. Gages, thermometers, valves and other devices shall be installed with due regard for ease in

reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

J. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.

K. Many plumbing systems interface with the HVAC control system. See the HVAC control points list.

L. Work in Existing Building:

1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will cause the least interfere with normal operation of the facility.

M. Work in Animal Research Areas: Seal all pipe penetrations with silicone sealant to prevent entrance of insects.

N. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers putty.

O. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.

P. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

### **3.2 TEMPORARY PIPING AND EQUIPMENT**

- A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Para. 3.1 shall apply.
- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

### **3.3 RIGGING**

- A. Openings in building structures shall be planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered and will be considered by Federal Government under specified restrictions of phasing and service requirements as well as structural integrity of the building.
- C. All openings in the building shall be closed when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.
- E. Contractor shall check all clearances, weight limitations and shall provide a rigging plan designed by a Professional Engineer currently licensed in the Commonwealth of Pennsylvania. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Rigging plan and methods shall be referred to COR for evaluation prior to actual work.

### **3.4 PIPE AND EQUIPMENT SUPPORTS**

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure

that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the COR.

- B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.
- C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 1/2-inch clearance between pipe or piping covering and adjacent work shall be provided.
- D. For horizontal and vertical plumbing pipe supports, refer to the International Plumbing Code (IPC), latest edition, and these specifications.
- E. Overhead Supports:
  - 1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
  - 2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
  - 3. Tubing and capillary systems shall be supported in channel troughs.
- F. Floor Supports:
  - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
  - 2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 2 inch excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
  - 3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.

### **3.5 LUBRICATION**

- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.
- B. All devices and equipment shall be equipped with required lubrication fittings. A minimum of one quart of oil and one pound of grease of manufacturer's recommended grade and type for each different application shall be provided. All materials shall be delivered to COR in unopened containers that are properly identified as to application.
- C. A separate grease gun with attachments for applicable fittings shall be provided for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
- E. All lubrication points shall be extended to one side of the equipment.

### **3.6 PLUMBING SYSTEMS DEMOLITION**

- A. Rigging access, other than indicated on the drawings, shall be provided after approval for structural integrity by the COR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, approved protection from dust and debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating plant, cleanliness and safety shall be maintained. The plant shall be kept in an operating condition. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work shall be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris shall not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting shall be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. All work shall be performed in accordance with recognized fire protection standards. Inspections will be made by personnel of the VA Medical Center, and the Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Government property. This includes all

concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.

- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

- E. Asbestos Transite Removal: Conform to Section 02 82 13-32 - ASBESTOS CEMENT PIPE ABATEMENT.

### **3.7 CLEANING AND PAINTING**

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted.
- B. In addition, the following special conditions apply:
1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
  2. The following Material And Equipment shall NOT be painted::
    - a. Motors, controllers, control switches, and safety switches.
    - b. Control and interlock devices.
    - c. Regulators.
    - d. Pressure reducing valves.
    - e. Control valves and thermostatic elements.
    - f. Lubrication devices and grease fittings.
    - g. Copper, brass, aluminum, stainless steel and bronze surfaces.
    - h. Valve stems and rotating shafts.

- i. Pressure gages and thermometers.
  - j. Glass.
  - k. Name plates.
3. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint obtained from manufacturer or computer matched.
4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
6. The final result shall be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this.

### **3.8 IDENTIFICATION SIGNS**

- A. Laminated plastic signs, with engraved lettering not less than 5 mm (3/16-inch) high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance shall be placed on factory built equipment.

### **3.9 STARTUP AND TEMPORARY OPERATION**

- A. Start up of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

### **3.10 OPERATING AND PERFORMANCE TESTS**

- A. Prior to the final inspection, all required tests shall be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of

tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.

- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests such systems respectively during first actual seasonal use of respective systems following completion of work.

### **3.11 OPERATION AND MAINTENANCE MANUALS**

- A. Provide four bound copies. The Operations and maintenance manuals shall be delivered to COR not less than 30 days prior to completion of a phase or final inspection.
- B. All new and temporary equipment and all elements of each assembly shall be included.
- C. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
- D. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.
- E. Lubrication instructions, type and quantity of lubricant shall be included.
- F. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.
- G. Set points of all interlock devices shall be listed.
- H. Trouble-shooting guide for the control system troubleshooting guide shall be inserted into the Operations and Maintenance Manual.
- I. The combustion control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.
- J. Emergency procedures.

### **3.12 INSTRUCTIONS TO VA PERSONNEL**

Instructions shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

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**SECTION 22 05 19**

**METERS AND GAGES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section describes the requirements for water meters and pressure gages.

**1.2 RELATED WORK**

Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Water Meter.
  - 2. Pressure Gages.
  - 3. BACnet communication protocol
  - 4. Product certificates for each type of meter and gauge
- C. Operations and Maintenance manual shall include:
  - 1. System Description
  - 2. Major assembly block diagrams
  - 3. Troubleshooting and preventive maintenance guidelines
  - 4. Spare parts information.
- D. Shop Drawings shall include the following:
  - 1. One line, wiring and terminal diagrams including terminals identified, protocol or communication modules, and Ethernet connections.

**1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI):
  - American Society of Mechanical Engineers (ASME): (Copyrighted Society)
  - B40.1-05.....Gauges-Pressure Indicating Dial Type-Elastic
- C. American Water Works Association (AWWA):
  - C700-07 (R 2003).....Standard for Cold Water Meters, Displacement Type, Bronze Main Case

C701-07.....Cold Water Meters-Turbine Type, for Customer  
Service AWWA/ ANSI

C702-01.....Cold water meters - Compound Type

D. International Code Council (ICC):

IPC-06.....(2007 Supplement) International Plumbing Code

### 1.5 AS-BUILT DOCUMENTATION

- A. The electronic documentation and copies of the Operations and Maintenance Manual, approved submittals, shop drawings, and other closeout documentation shall be prepared by a computer software program complying with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C 794d). The manufacturer or vendor of the software used to prepare the electronic documentation shall have a Voluntary Product Accessibility Template made available for review and included as part of the Operations and Maintenance Manual or closeout documentation. All available accessibility functions listed in the Voluntary Accessibility Template shall be enabled in the prepared electronic files. As Adobe Acrobat is a common industry format for such documentation, following the document, "Creating Accessible Adobe PDF files, A Guide for Document Authors" that is maintained and made available by Adobe free of charge is recommended."
- B. Four sets of manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- C. Four sets of operation and maintenance data updated to include submittal review comments shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the Government will be required to employ shall be inserted into the As-Built documentation.

## **PART 2 - PRODUCTS**

### **2.1 DISPLACEMENT WATER METER**

Not included for this project.

### **2.2 TURBINE WATER METER**

### **NOT INCLUDED FOR THIS PROJECT. 2.3 COMPOUND WATER METER.**

Not included for this project.

### **2.4 WATER METER STRAINER**

Not included for this project.

### **2.5 WATER METER PROGRAMMING**

Not included for this project.

### **2.6 WATER METER COMMUNICATION PROTOCOL**

Not included for this project.

### **2.7 PRESSURE GAGES FOR WATER AND SEWAGE USAGE**

- A. ANSI B40.1 all metal case 4-1/2 inches diameter, bottom connected throughout, graduated as required for service, and identity labeled. Range shall be 0 to 160 psi gauge.
- B. The pressure element assembly shall be bourdon tube. The mechanical movement shall be lined to pressure element and connected to pointer.
- C. The dial shall be non-reflective aluminum with permanently etched scale markings graduated in psi.
- D. The pointer shall be dark colored metal.
- E. The window shall be glass.
- F. The ring shall be brass or stainless steel.
- G. The accuracy shall be grade A, plus or minus 1 percent of middle half of scale range.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Direct mounted pressure gages shall be installed in piping tees with pressure gage located on pipe at the most readable position.
- B. Valves and snubbers shall be installed in piping for each pressure gage.
- C. Test plugs shall be installed on the inlet and outlet pipes all heat exchangers or water heaters serving more than one plumbing fixture.
- D. Pressure gages shall be installed where indicated on the drawings and at the following locations:
  - 1. Building water service entrance into building
  - 2. Inlet and outlet of each pressure reducing valve

3. Suction and discharge of each domestic water pump or re-circulating hot water return pump.

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**SECTION 22 05 33  
HEAT TRACING FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section describes the requirement for supplying, installing, and testing of the electric heat tracing system of the plumbing piping.

**1.2 RELATED WORK**

- A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. The following product data shall be submitted:
  - 1. Rated capacity
  - 2. Length of cable
  - 3. Cable spacing
  - 4. Electrical power requirements
- C. The shop drawings shall include plans, sections, details, wiring diagrams, and attachments to other work. The wiring diagrams shall include power, signal, and control wiring.
- D. Field quality control test reports shall be submitted.
- E. Operation and Maintenance data shall be included.

**1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  - 1. Ten years experience in design, engineering, manufacture and support of specified system and components.
- B. Product Requirements:
  - 1. Pipe or tank tracing cable assembly shall be factory assembled, immersed in water for a minimum of 12 hours, and then tested for insulation resistance, high potential breakdown and continuity before leaving the factory.
  - 2. Factory Mutual approved constant wattage cable.
  - 3. UL Listed, thermostat and contactor panel.
  - 4. UL Listed Control/Monitor Panel

#### **1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. International Code Council, (ICC):  
IPC-06, (R 2007).....International Plumbing Code
- C. The Institute of Electrical and Electronic Engineers (IEEE):  
IEEE 515.1, (R 2007)....Recommended Practice for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Commercial Applications

#### **1.5 AS-BUILT DOCUMENTATION**

- A. The electronic documentation and copies of the Operations and Maintenance Manual, approved submittals, shop drawings, and other closeout documentation shall be prepared by a computer software program complying with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C 794d). The manufacturer or vendor of the software used to prepare the electronic documentation shall have a Voluntary Product Accessibility Template made available for review and included as part of the Operations and Maintenance Manual or closeout documentation. All available accessibility functions listed in the Voluntary Accessibility Template shall be enabled in the prepared electronic files. As Adobe Acrobat is a common industry format for such documentation, following the document, "Creating Accessible Adobe PDF files, A Guide for Document Authors" that is maintained and made available by Adobe free of charge is recommended."
- B. Four sets of manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- C. Four sets of operation and maintenance data updated to include submittal review comments shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks

shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

## **PART 2 - PRODUCTS**

### **2.1 SELF REGULATING PARALLEL RESISTANCE HEATING CABLES**

- A. The heating element shall be a pair of parallel No. 12 AWG nickel coated stranded copper bus wires embedded in cross linked conductive polymer core, which varies heat output in response to temperature along its length. Cables shall be terminated with waterproof, factory assembled non heating leads with connects at one and seal the opposite end watertight. The cable shall be capable of crossing over itself without overheating.
- B. The electrical insulating jacket shall be flame retardant polyolefin.
- C. The cable cover shall be braid and polyolefin outer jacket with UV inhibitor.
- D. The maximum power on operating temperature shall be 150°F.
- E. The maximum power off exposure temperature shall be 185°F
- F. The capacities and characteristics shall be:
  - 1. Maximum heat output: 8.0 W/foot
  - 2. Pipe Diameter: 12 and 8 inches
  - 3. Number of parallel cables: one
  - 4. Volts: 240
  - 5. Phase: single
  - 6. Hertz: 60
  - 7. Full load amps: 8A
  - 8. Minimum circuit ampacity: 20A
  - 9. Maximum over current Protection: 20A

### **2.4 CONTROLS**

- A. Pipe mounting thermostats for Freeze protection shall have be a remote bulb unit with adjustable temperature range from minus 30 to 50°F. The thermostat shall be snap action, open-on-rise, single pole switch with minimum current rating adequate for the connected cable. The thermostat shall be remote bulb on capillary, resistance temperature device, or thermistor for direct sensing of pipe wall temperature. The control enclosure shall be corrosion resistant and waterproof.

- B. The enclosure shall be corrosion resistant and waterproof suitable for outdoor mounted.
- D. A minimum 20 amp contactor shall be provided to indicate operational status, on/off control, and for interface with central energy management and control system.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Electric heating cable shall be installed for the following applications:
  - 1. Self regulating parallel resistance cable shall be installed for temperature maintenance for domestic hot water.
  - 2. Freeze protection of plumbing piping.
- B. Electric heating cable shall be installed across expansion, construction, and control joints according to the manufacturer's recommendations using cable protection conduit and slack cable to allow for movement without damage to cable.
- C. The installation of electric heating cable for snow and ice melting on roofs, gutters, and roof drain leaders shall be provided with clips furnished by the manufacturer that is compatible.
- D. Electric heating cable for pipe freeze protection shall be installed according to the following:
  - 1. Electric heating cables shall be installed after piping has been tested and before insulation is installed.
  - 2. Electric heat cables shall be installed according to IEEE 515.1
  - 3. Insulation shall be installed or applied over piping with electric cables
  - 4. Warning tape shall be installed on pipe insulation where piping is equipped with electric heating cables.
- E. Electric heating cable for domestic hot water temperature maintenance shall be installed according to the following:
  - 1. Electric heating cables shall be installed after piping has been tested and before insulation is installed.
  - 2. Insulation shall be installed or applied over piping with electric cables
  - 3. Warning tape shall be installed on pipe insulation where piping is equipped with electric heating cables.



- F. Field adjustable switches and circuit breaker trip ranges shall be set.
- G. Heating cables including leads shall be protected from damage.
- H. Equipment shall be grounded according to Division 26.
- I. Wiring shall be connected according to Division 26.

### **3.2 TESTS**

- A. Tests shall be performed after cable installation but before the application of coverings such as insulation, wall or ceiling construction, or concrete. The cables shall be tested for electrical continuity and insulation integrity before energizing. The cables shall be tested to verify rating and power input. The cables shall be energized and voltage and current measured simultaneously. Test repeatedly after repairing heating cables with new products.

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**SECTION 22 07 11  
PLUMBING INSULATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Field applied insulation for thermal efficiency and condensation control for
  - 1. Plumbing piping and equipment.
- B. Definitions
  - 1. ASJ: All service jacket, white finish facing or jacket.
  - 3. Cold: Equipment or piping handling media at design temperature of 60 degrees F or below.
  - 5. Exposed: Piping and equipment exposed to outdoor weather.
  - 6. FSK: Foil-scrim-kraft facing.
  - 8. Density: Pcf - pounds per cubic foot.
  - 9. Thermal conductance: Heat flow rate through materials.  
Pipe or Cylinder: BTU per hour per linear foot.
  - 10. Thermal Conductivity (k): BTU per inch thickness, per hour, per square foot, per degree F temperature difference.
  - 11. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.
  - 12. CW: Cold water.

**1.2 RELATED WORK**

- A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.
- B. Section 22 05 19, GAGES FOR PLUMBING PIPING.

**1.3 QUALITY ASSURANCE**

- A. Refer to article QUALITY ASSURANCE, in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA.
- B. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.

- a. Insulation materials: Specify each type used and state surface burning characteristics.
- b. Insulation facings and jackets.
- c. Insulation accessory materials.

#### **1.5 STORAGE AND HANDLING OF MATERIAL**

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

#### **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Federal Specifications (Fed. Spec.):  
L-P-535E (2)-91.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- C. Military Specifications (Mil. Spec.):  
MIL-A-3316C (2)-90.....Adhesives, Fire-Resistant, Thermal Insulation  
MIL-C-19565C (1)-88.....Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier  
MIL-C-20079H-87.....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass
- D. American Society for Testing and Materials (ASTM):  
A167-04 .....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip  
B209-07.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate  
C585-09.....Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System) R (1998)

- C1136-10 .....Standard Specification for Flexible, Low  
Permeance Vapor Retarders for Thermal  
Insulation
- E84-10 .....Standard Test Method for Surface Burning  
Characteristics of Building  
Materials
- E. National Fire Protection Association (NFPA):
  - 101-09 .....Life Safety Code
  - 251-06.....Standard methods of Tests of Fire Endurance of  
Building Construction Materials
  - 255-06.....Standard Method of tests of Surface Burning  
Characteristics of Building Materials
- F. Underwriters Laboratories, Inc (UL):
  - 723.....UL Standard for Safety Test for Surface Burning  
Characteristics of Building Materials with  
Revision of 08/03
- G. Manufacturer's Standardization Society of the Valve and Fitting  
Industry (MSS):
  - SP58-2002.....Pipe Hangers and Supports Materials, Design,  
and Manufacture

## **PART 2 - PRODUCTS**

### **2.1 POLYISOCYANURATE CLOSED-CELL RIGID**

- A. Preformed (fabricated) pipe insulation, ASTM C591, type IV, K=0.19 at  
75 degrees F, flame spread not over 25, smoke developed not over 50,  
for use at temperatures up to 300 degree F with factory applied PVDC or  
all service vapor retarder jacket with polyvinyl chloride premolded  
fitting covers.

### **2.2 INSULATION FACINGS AND JACKETS**

- A. Vapor Retarder, higher strength with low water permeance = 0.02 or less  
perm rating, Beach puncture 50 units for insulation facing on pipe  
insulation jackets. Facings and jackets shall be all service type (ASJ)  
jacketing.
- C. Field applied vapor barrier jackets shall be provided, in addition to  
the specified facings and jackets, on all exterior piping. The vapor  
barrier jacket shall consist of a multi-layer laminated cladding with a

maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 80 inch-pounds for exterior or exposed locations or where the insulation is subject to damage.

- E. Aluminum Jacket-Piping systems and circular breeching and stacks: ASTM B209, 3003 alloy, H-14 temper, 0.023 inch minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.024 inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 0.5 inch wide on 18 inch centers. System shall be weatherproof if utilized for outside service.
- I. Aluminum jacket-Rectangular breeching: ASTM B209, 3003 alloy, H-14 temper, 0.020 inches thick with 1-1/4 inch corrugations or 0.032 inches thick with no corrugations. System shall be weatherproof if used for outside service.

### 2.3 PIPE COVERING PROTECTION SADDLES

- A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 3.0 pcf.

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size, inches	Insert Blocks, inches
8, 10, 12	9 long
14, 16	12 long

### 2.4 ADHESIVE, MASTIC, CEMENT

- A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
- B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
- D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.
- G. Other: Insulation manufacturers' published recommendations.

## **2.5 MECHANICAL FASTENERS**

- A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching galvanized steel
- C. Wire: 18 gage soft annealed galvanized or 14 gage copper clad steel or nickel copper alloy.
- D. Bands: 1/2 inch nominal width, brass, galvanized steel, aluminum or stainless steel.

## **2.6 REINFORCEMENT AND FINISHES**

- A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).
- B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.
- C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
- D. Hexagonal wire netting: one inch mesh, 22 gage galvanized steel.
- E. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 40 degrees F to 250 degrees F. Below 40 degrees F and above 250 degrees F. Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

## **PART 3 - EXECUTION**

### **3.1 GENERAL REQUIREMENTS**

- A. Required pressure tests of piping joints and connections shall be completed and the work approved by the COR for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.
- D. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 60 degrees F and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 6 inches.

- E. Install vapor stops at all insulation terminations on either side of valves, and particularly in straight lengths of pipe insulation.
- F. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.
- I. Plumbing work not to be insulated:  
Water piping in contact with earth.
- J. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- K. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights.
- L. Freeze protection of above grade outdoor piping (over heat tracing tape): 1 inch thick insulation for 8-12 inches pipes. Provide metal jackets for all pipes.
- N. Provide vapor barrier jackets over insulation as follows:
  - 1. All piping exposed to outdoor weather.
- O. Provide metal jackets over insulation as follows:
  - a. All plumbing piping exposed to outdoor weather.

### **3.2 INSULATION INSTALLATION**

- A. Polyisocyanurate Closed-Cell Rigid Insulation:
  - 1. Polyisocyanurate closed-cell rigid insulation (PIR) may be provided for exterior piping for temperature up to 300 degree F.
  - 2. Install insulation, vapor retarder and jacketing per manufacturer's recommendations. Particular attention should be paid to recommendations for joint staggering, adhesive application, external hanger design, expansion/contraction joint design and spacing and vapor retarder integrity.
  - 3. Install insulation with all joints tightly butted (except expansion joints in hot applications).
  - 4. If insulation thickness exceeds 2.5 inches, install as a double layer system with longitudinal (lap) and butt joint staggering as recommended by manufacturer.
  - 5. For cold applications, vapor retarder shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor retarder shall be used to attach the vapor retarder or jacketing. No wire ties capable

of penetrating the vapor retarder shall be used to hold the insulation in place. Banding shall be used to attach PVC or metal jacketing.

6. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting.
7. For cold applications, the vapor retarder on elbows/fittings shall be either mastic-fabric-mastic or 2 mil thick PVDC vapor retarder adhesive tape.
8. Note the NFPA 90A burning characteristic requirements of 25/50 in paragraph 1.3B. Refer to paragraph 3.1 for items not to be insulated.
10. Minimum thickness in inches specified in the schedule at the end of this section.

### 3.3 COMMISSIONING

- A. Provide commissioning documentation for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system.

### 3.4 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)		
		Nominal Pipe Size Millimeters (Inches)
Operating Temperature Range/Service	Insulation Material	4 and Above
40-60 degrees F	Polyiso-cyanurate Closed-Cell Rigid(Exterior Locations only)	1.0

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**SECTION 22 12 16**  
**FACILITY ELEVATED, POTABLE-WATER STORAGE TANKS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. An elevated steel water storage tank and tower, completed, including risers, piping, drains, materials, labor, equipment, painting, sterilization and all accessories as required.

**1.2 RELATED WORK**

- A. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- B. Lightning Protection: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- C. Hazard Lighting: Division 26.
- D. SEISMIC PROTECTION: Department of Veterans Affairs Seismic design requirements H-18-8 (2008) IBC and local building code.

**1.3 QUALITY ASSURANCE**

- A. Criteria:
  - 1. Manufacturer regularly and presently manufactures the item submitted as one of their principal products.
  - 2. Installer, or supplier of a service, has technical qualifications, experience, trained personnel, and facilities to perform the specified work.
  - 3. Submit a list of five completed projects of similar type and references with current position, address, telephone number, and e-mail.
- B. System Requirements: AWWA D100 for steel tanks plus the following:
  - 1. Steel Tower Supporting Elevated Water Tank Design Loads:
    - a. Weight of Tank and Water.
    - b. Wind Load.
    - c. Seismic Load.
    - d. Combined Loads: Design for the worst case:
      - 1) Gravity and wind.
      - 2) Gravity and seismic.
    - e. Snow Load.
    - f. Design Code: American Institute of Steel Construction Specification (AISC) for Structural Steel for Buildings - Allowable Stress Design and Plastic Design.
  - 2. IBC and local building codes.

#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. All construction drawings to have a PE Stamp.
- B. Manufacturers' Literature and Data:
  - 1. Piping.
  - 2. Valves.
  - 3. Floor Drain.
  - 4. Steel Tank and Accessories.
  - 5. Alarm System.
  - 6. OSHA approved climbing equipment for maintenance personnel.
  - 7. Tank Piping Heat Trace Equipment.
  - 8. Lightning Protection.
  - 9. Paint.
- C. Calculations and completely detailed erection procedure with and shop drawings.
- D. Design calculations for the mechanical mixer system, including documentation of the Computational Fluid Dynamics (CFD) model parameters and assumptions, tank geometry and dimensions considered, mesh information, and CPU time required. Analysis should include the velocity vectors and contour plot, average flow induced, average turnover in hours, and average power consumption.
- E. The passive mixer system manufacturer shall be responsible for designing the system in accordance with the hydrodynamic criteria defined within these specifications and submit design calculations verifying compliance:
  - 1. Calculations showing the fill time required for the system to achieve complete mix (95% homogenous solution) of the reservoir volume at minimum, average and peak fill rates.
  - 2. A representative Computational Fluid Dynamics (CFD) model evaluation of the proposed system configuration applied within a reservoir of similar geometry. Model output documentation shall include all design variables applied for the simulation, plot of the 3-D geometry showing the mesh definition, velocity magnitude vector and contour plots at different cross-sections throughout the water volume.
  - 3. Hydraulic calculations showing the resulting jet velocities of each inlet nozzle, flow distribution among all inlet ports, and total headloss at minimum, average, and peak fill rates.

4. Hydraulic curves showing thrust vs. flow for the inlet nozzles.
  5. Hydraulic curves for each outlet check valves showing headloss vs. flow.
- F. Foundation, footings and calculation, designed and sealed by a professional Structural Engineer currently licensed in the Commonwealth of Pennsylvania.
- G. Copies of the NSF-61 certified listing for all material being placed inside the tank and headspace, including cables.

#### **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 Institute of Steel Construction (AISC):  
AISC 325-05 (Steel construction Manual, Thirteenth Edition).
- C. American Society of mechanical Engineers (ASME):  
ANSI/ASME A112.6.3-2001 Floor and Trench Drains  
ANSI/ASME A112.6.3-2001 Cast Iron Pipe Flanges and Flanged Fittings  
ANSI/ASME B16.1 - 2005 Gray Iron Pipe Flanges and Flanged Fittings; Classes 25, 125, 250.  
ASME/ANSI B16.34 - 2009 Valves, flanged, threaded and welded end.  
ASME/ANSI B16.5 - Pipe Flanges and Flanged Fittings  
ASME/ANSI B36.10 - ANS Weights and Dimensions of Welded and Seamless Wrought Steel Pipe
- D. American Society of Civil Engineers (ASCE):  
Minimum Design Loads for Buildings and Other Structures - ASCE/7-05.
- E. American Society for Testing and Materials (ASTM):  
A36/A36M-08.....Standard Specification for Carbon Structural Steel  
A53/A53M-07.....Standard Specification for Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless  
A123/A123M-09.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products  
A153/A153M-09.....Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

- A234/A234M-07.....Piping Fittings of Wrought Carbon Steel and Alloy Steel For Moderate and High Temperature Service
- A351 .....Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
- D1330.....Standard Specification for Rubber-Sheet Gaskets
- F. American Water Works Associations (AWWA):
- C110/A21.10-03.....Ductile-Iron and Gray-Iron Fittings for Water
- C115/A21.15-05.....Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
- C151/A21.51-09.....Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
- B300-10.....Standards for Hypochlorites
- B301-10 10.....Standards for Liquid Chlorine
- C200.....AWWA Standard for Steel Water Pipe 6" and Larger
- C207.....Standard for Steel Pipe Flanges for Waterworks Service - Size 4" to 144"
- C220.....AWWA Standard for Stainless Steel Pipe, 4" and Larger
- C652-02.....Disinfection of Water Storage Facilities
- D100-05.....Welded Steel Tanks for Water Storage
- ANSI/AWWA D102-06.....Coating Steel Water-Storage Tanks
- G. International Building Code: 2009
- H. National Fire Protection Association (NFPA):
- NFPA 22-08 .....Water Tanks for Private Fire Protection
- NFPA 25-08 .....Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems
- I. Department of Veterans Affairs (Handbook):
- H-18-8 (2008).....Seismic Design Requirements
- J. NSF INTERNATIONAL (NSF)
- NSF/ANSI 61 (2010) Drinking Water System Components -Health Effects

## **PART 2 - PRODUCTS**

### **2.1 TANK**

- A. Shall be in accordance with NFPA 22, AWWA D-100-05 and ASTM A36.
- B. The tank shall be of pedestal spheroid type.

- C. The tank shall be constructed of one quarter inch minimum thick steel plus .01" for corrosion allowance. Tank shall be welded throughout.
- D. The wind loading shall be 30.3 lb/ft<sup>2</sup> on the vertical surfaces, 18.2 lb/ft<sup>2</sup> on the projected areas of cylindrical surfaces and 18.2 lb/ft<sup>2</sup> on projected area of conical and double-curved plate surfaces. The entire structure shall withstand 90 mph (3 second gust) winds.
- E. Design the tank to withstand earthquake zone "LOW" as defined by the Veterans Affairs Handbook H-18-8 International Building Code Requirement .
- F. The balcony and ladder loading shall be as specified in AWWA D100, furnish OSHA approved climbing equipment.

## **2.2 FOUNDATION**

- A. The elevated water tower contractor shall be responsible for the soil borings, design and installation of the foundation and footings.
- B. The soil borings shall be performed by an independent and established soils engineering firm.

## **2.3 ACCESSORIES**

- A. Comply with NFPA No. 22 and AWWA D100-05. Main riser and overflow shall be schedule 40 steel, ASTM A53 with schedule 40, ASTM A234, butt welded fittings.
- B. The main tank riser shall be 12 inch.
- C. Overflow: Provide a 12-inch steel pipe extended to grade with an overflow visible before spilling into the discharge point. The overflow shall be provided with an insect screen and splash block.
- D. Perimeter Safety Railing for Riser Opening in Tank: Provide a circular steel railing around perimeter of riser opening in bottom of tank. Railing shall be 3 feet 6 inches high and constructed of four 2 inch by 2 inch by 3/8 inch angle uprights welded to riser compression ring or tank construction at bottom, one 2 inch by 2 inch by 3/8 inch circular angle top member, and two 1-1/2 inch by 1/4 inch circular bars with first bar located 8 inches above bottom of tank, and second bar at midpoint between first bar and top member of railing.
- E. Vent: Vent shall be welded to the cover plate of the center manhole on the roof. Vent will be tank manufacturer's standard type mushroom vent with aluminum bird screen. The free area of the vent shall be sized 50 percent in excess of the 2,500 gpm pump-in rate and 2,500 gpm pump-out rate. Screening for vent shall conform to Section 5.7.2 of AWWA D100. Ensure fail-safe operation in the event that screen frosts over and the

bottom of the screen shall be sufficiently elevated for snow consideration in the area.

- I. Ladders and Safety Devices: Ladders and safety devices shall be provided in accordance with Sections 7.4 and 7.5 of AWWA D100. Location of ladders shall be as shown on the drawings. Sections 7.4 and 7.5 of AWWA D100 represent the minimum requirement. In addition, safety cage, rest platforms, roof ladder handrails, and other safety devices shall be provided as required by federal or local laws or regulations. Post shall be high-strength aluminum 6061-T6 square tubing, with a mill finish, retractable, and shall automatically lock when fully extended. Post shall extend at least 42" above top of hatch in raised position, and shall bear a pull-up loop at the top end. Provide a stainless steel spring balancing mechanism to allow for a smooth, controlled operation when raising and lowering the safety post. Spring nuts shall be galvanized steel; all other mounting hardware shall be Type 316 stainless steel. Product shall come pre-assembled from the manufacturer. Ladder shall be equipped with safety climb device. Contractor shall furnish a full body harness that is in accordance with OSHA requirements.
- J. Balconies (if required by contract drawings): Provide a balcony a minimum of 2 feet wide with a standard guard railing. Provide a structural steel railing with a top rail 42 inches above balcony platform with an intermediate rail halfway between. Guard rail shall be capable of withstanding a force of 200 pounds applied in any direction. Install a steel toe board with minimum height of 4 inches. Bottom of toe board shall be a maximum 1/4 inch from platform top. Extend guard rail and toe board entire length of balcony except where access openings are required. For balcony floors use diamond plates a minimum of 1/4 inch thick, punched or drilled for drainage. Equip access openings in guard rail with a gate which closes automatically. Hatches through balcony floor shall be counterbalanced or otherwise arranged to open from below.
- K. Metal Handrails and Railings for Roof Access: Metal handrails and railings provided shall be made of aluminum and shall be in accordance with requirements set forth by the Occupational Safety and Health Administration (OSHA). As well as the International Building Code, 2009. Aluminum alloy shall be in accordance with the Aluminum Association - Aluminum Construction Manual, ASTM A193, as well as the

American Society of Civil Engineers - Proceeding Paper 970, Aluminum Alloy. In general, handrails and railings are to be of circular cross-section fabricated from aluminum alloy 6061-T6 Schedule 40 circular pipe. Circular section railings are to be used at all locations. The metal railing system at all such locations is to consist of two (2) horizontal rails with the top rail set at 3'-6" above the floor or walking surface unless otherwise indicated. All railing posts are to be reinforced with 1-1/2" O.D. solid round bars of 6061-T6 aluminum as indicated on the Contract Drawings. Aluminum for all railing systems is to have a mill finish, unless otherwise indicated. Shop drawings, tests, samples, and product literature are to be submitted for review prior to fabrication or delivery of any handrails and railings. No fabrication, delivery or installation is to begin without the Engineer's review of submittals and samples. Toe plates are to conform to the following design criteria: 4" x 1/4" plate aluminum alloy type 6061-T6 with mill finish. The completed rail system, including post and railing anchorage, is to be capable of withstanding simultaneous uniform loads of fifty (50) pounds per linear foot applied horizontally at the top of the railing and one hundred (100) pounds per linear foot applied vertically downward at the top of the railing, and a nonconcurrent concentrated load of two hundred (200) pounds applied at any point in any direction. All handrails and railings are to be provided with a clearance of not less than 3" between adjacent construction, unless otherwise shown. Railing posts are to be spaced at uniform distances of not more than 4'-6" centers. All fastenings for aluminum work are to be of stainless steel of 5/8" minimum diameter. Expansion bolts will be permitted in concrete construction. Toggle bolts may be permitted in masonry construction. Aluminum attached to steel is to be accomplished by means of stainless steel fasteners and micarta insulating strips.

## **2.4 PIPING**

### **A. Pipe:**

#### **1. Ductile Iron:**

- a. Underground: AWWA C151, working pressure 150 psig, exterior bituminous coating and interior cement lining.
- b. In Pits, Tank Bell, and Above Ground: AWWA C115, flanged joints only, working pressure 150 psig.

2. Steel (Above Ground Only): Galvanized, ASTM A53, standard weight, screwed flanges, ASME B16.1, class 125.

B. Fittings: Ductile-iron, AWWA C110.

## **2.5 VALVES**

- A. Altitude: 8" differential type, hydraulically operated, diaphragm-actuated iron body, bronze mounted, self-contained unit. Valve shall be drip tight with a positive shut-off and a completely automatic operation.
  1. Single Acting Valve: Shall remain closed against upstream pressure until water level in tank drops to a point 2 feet below tank overflow invert high elevation (refer to Contract Drawings.
  3. Altitude valve shall include a standard pilot system with temperature range for water to 180°F, Bronze ASTM B62 pilot control, Stainless Steel Type 303 Trim, and Buna-N Synthetic Rubber, capable of size and head range of valve.
- B. Check: Iron body, bronze trim swing type, vertical or horizontal installation, flange connection, 200 psig WOG, Underwriters Laboratories Inc. approved.
- C. Gate: Fed Spec WW-V-58, Type II, class 1, flanged, non-rising stem type. Valve shall turn counterclockwise to open. Furnish hand wheel for operation. Ends of valves shall suit, or be adapted to pipe furnished.

## **2.6 TANK BELL\VALVE CHAMBER:**

- A. Tank bell (or valve chamber) shall be sufficiently large to house all control valves and fittings; and allow for unobstructed maintenance and replacement. Pipes, valves, and fittings shall be supported on concrete blocks where necessary. Piping within the tank bell (or valve chamber) shall be routed as shown on the drawings, so that 4 feet of cover is maintained over the pipes upon leaving the tank bell. The valves and fittings shall extend from the riser pipe connection to connection points with the existing main as shown on the drawings. Tank drain to be routed by the Contractor as directed by the Government. The access manhole shall be not less than 30 inches in diameter.
- B. 12-inch expansion joint for inlet/outlet pipe shall be provided.

## **2.7 FLOOR DRAIN**

ASME A112.6.3-2001, Cast iron with light duty grate.

- A. Bottom outlet.
- B. Side outlet.



## **2.8 HIGH AND LOW WATER LEVEL ALARM SYSTEMS**

- A. Provide high and low level devices for alarm monitoring and an intermediate device for tank water level status.
  - 1. All three water levels shall be indicated by their respective pilot lights; green for high, amber for intermediate and red for low water levels, and a buzzer for low and high water levels.
  - 2. Buzzer and the respective pilot lights at high and low water levels shall be energized while the high or low water level pilot device is actuated.
  - 3. Depressing a silencing button shall silence the buzzer indicating the water level and shall remain in OFF condition. The pilot light shall remain energized.
  - 4. Resetting the pilot light shall de-energize the pilot light and release the buzzer from its sealed-off condition.
  - 5. Provide alarming contacts to a DDC (Direct Digital Controls) remotely to the ECC (Engineering Control Center) operator.

## **2.9 TANK HEATING**

NOT INCLUDED FOR THIS PROJECT

## **2.10 MECHANICAL TANK MIXING SYSTEM**

- B. Furnish and install submersible mixing system together with all drives, motors, controls, and accessories necessary for a complete and operable system.
- C. Components on the wet-side of the system shall be NSF/ANSI Standard 61 certified.
- D. Performance: based on models validated and/or calibrated with experimental data from laboratory-scale and real scale representative systems for similarly-sized reservoirs, manufacturer shall show mixing system shall have an output flow-rate that is equal to, or larger than, the following: 5,000 GPM. These requirements can be measured and validated after installation by operators with readily-available tools such as temperature probes and total chlorine grab samplers.
  - 1. Temperature Uniformity. For tanks larger than 80 feet in height or 3 million gallons in volume, all temperatures shall converge to within 0.2°C within 72 hours after mixer is installed and activated. During continuous operation of the mixer, all temperatures will converge to within 0.2°C at least once every 24 hours.
  - 2. Disinfectant Residual Uniformity. For tanks larger than 80 feet in height or between 3 and 7 million gallons in volume, disinfectant

residual within top five feet of tank and bottom five feet of tank will converge to within 0.20 ppm within 7 days after mixer is installed and activated. During continuous operation of the mixer, disinfectant residual will converge to within 0.20 ppm at least once every 72 hours.

E. Mechanical mixing system must consist of the a impeller, motor, and mounting system and meet the follow criteria:

1. Impeller shall be AISI Type 316 Stainless Steel, balanced to within 0.5 gram-inches, passivated per ASTM A380 to minimize corrosion, no greater than 8 inches in height, no greater than 4.5 inches in diameter, no more than 2.2 lbs in weight, and must not create cavitation at any rotational speed up 2500 RPM.
2. Motor shall have AISI Type 316 Stainless Steel body. Must have Chlorine/Chloramine resistant rubber seals, and be fully submersible. Must be Low Voltage (10-45V), High Voltage motor shall not be permitted. Motor shall be 0.5 HP or less, water-filled, water lubricated, and shall be Variable RPM capable.
3. Mounting system with EPDM insulated hose clamp, strain relief, and a motor cable of adequate length. Mounting system is to be designed and provided by the mechanical mixer manufacturer.

F. Components: each 110VAC control center shall consist of the following components:

1. Enclosure: lockable, with an over-hanging lip as moisture seal, vandal-resistant, 14 gauge, AISI Stainless Steel 304 construction. Overall weight of control center not to exceed 50 lbs.
2. Power supply: 48V DC power supply, with an operating temperature range -40°C to +70°C, automatic Thermal shut-off protection built-in, a Power Factor meeting EN61000-3-2, RoHS-compliant design.
3. Motor Controller: conformal-coated PC Board to control motor speed, Green and Red LED Indicator lights show motor status, operating temperature range -40°C up to 85°C, manual speed control located on board (potentiometer), thermal shut-off protection built-in, and current overload protection built-in
4. SCADA Control Board: conformal-coated, Digital Output signal indicating motor running, Digital Output signal indicating fault, Digital Input/output signal allowing remote motor on/off, RS-232

or dry contact connections, Green and Red LED status indicator lights connected on enclosure

- G. All motors and controls which interface with 110VAC grid power shall be connected to a dedicated branch circuit, 15-Amp, 5mA trip level, GFCI-protected 120-volt, 60-Hz, single-phase connection at the control center.
- H. Controls: each unit shall be equipped with all necessary controls, interwired, to provide the following minimum functions: On/Off switch to control power to mixer, Automatically-activated motor shut-off if water level drops below motor height in tank, Any other controls shown on electrical and instrumentation drawings.
- I. GFCI-Protected Disconnect Switch: Each unit shall have a dedicated 15-Amp, 5mA trip level, GFCI circuit breaker for 120-volt, 60-Hz, single-phase grid power. Connection from circuit breaker to control center shall terminate in a disconnect switch located within 10 feet (3m) of mixer control center. Disconnect switch shall be housed in a lockable, waterproof (NEMA 3r minimum) housing.

## **2.11 PASSIVE TANK MIXING SYSTEM**

- A. Furnish and install a passive hydraulic mixing system.
- B. The passive tank mixing system shall be equipped with variable orifice duckbill-style check valves. Inlet ports/nozzles may not be fixed-diameter ports or pipes. The duckbill style nozzles shall be one-piece elastomer matrix with internal fabric reinforcing designed to produce the required discharge velocity and minimum headloss requirements as stipulated in the Submittals section. The flange portion shall be an integral portion of the nozzle with fabric reinforcing spanning across the joint between the flange and nozzle body. The elastomer used in construction of the duckbill valves must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property - Effect of Liquids."
- C. The passive tank mixing system shall be equipped with perforated disc type outlet check valves with elastomeric membrane. The perforated disc shall be fabricated of stainless steel plate with welded support gussets. The disc shall be flanged and drilled to mate with ANSI B16.1, Class 125/ANSI B16.5 Class 150 flanges. The disc shall have three (3) tapped holes used for fastening the membrane and support rod

to the disc with stainless steel bolts, nuts, and lock washers. The top of the disc shall be tapped and supplied with lifting eyebolt for installation. The membrane shall be circular, one piece rubber construction with fabric reinforcement. The support rod shall be stainless steel and drilled with three (3) longitudinal holes to allow fastening of rod to membrane and perforated disc.

- D. The elastomer used in construction of the membrane must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property - Effect of Liquids."
- E. Carbon Steel Pipe and Fittings shall conform to the associated standards listed in Section 3.0: Reference Standards. Ring flanges shall be continuously welded on both sides.
- F. Fasteners: Hex head bolts and nuts shall be stainless steel 304 conforming to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.
- G. Following installation of the manifold system, all carbon steel and ductile iron pipe, fittings, bolted connections, pipe supports, and appurtenances shall be coated according to the interior tank paint specification as specified by the Engineer. The valves shall either be masked or be mounted after coating of the tank and piping. Contractor to ensure masking materials are removed after coating.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install tank and tower in accordance with AWWA D100 and NFPA 22 requirements.
- B. Install safety ladders in accordance with NFPA 22 and OSHA requirements.

#### **3.2 TANK INSPECTION**

- A. Comply with AWWA and NFPA 25 requirements.

#### **3.3 LEAKAGE TEST:**

- A. Comply with AWWA, NFPA 22 and NFPA 25 requirements.

#### **3.4 LIGHTNING PROTECTION**

- A. Comply with NFPA 22.

#### **3.5 FIELD PAINTING**

- A. After construction, all weld seams, unprimed margins, field bolts, lugs and any area where the factory primer has been damaged shall be blast cleaned and re-primed with the same factory primer. Apply paint in

accordance with NFPA 22 and AWWA D102. The exterior paint color and the VAMC logo shall be as directed by the VAMC.

### **3.7 FLUSHING**

- A. After tests and painting, flush tank and connecting pipelines.

### **3.8 DISINFECTION/ STERILIZATION**

- A. After flushing, thoroughly disinfect and sterilize the tank and connecting piping with a chlorine and hypochlorite solution as required by AWWA C652. Following a contact period of 24 hours, flush the system with clean water until the residual chlorine content is not greater than that of the water supply. All valves in water line being disinfected shall be opened and closed several times during the 24 hour period. Hypochlorite material shall comply with Fed Spec O-C-114 or Fed Spec O-S-602, grade B.
- B. Hypochlorite material shall comply with AWWA B300-10.
- C. Heavy chlorinated water shall be disposed of in accordance with AWWA C652. The environment into which the chlorinated water is to be discharged shall be inspected, and if there is any likelihood that the chlorinated discharge will cause damage, then a reducing agent shall be applied to the water to be wasted to thoroughly neutralize the chlorine residual in the water. Federal, state, or local environmental regulations may require special provisions or permits prior to disposal of highly chlorinated water. The proper authorities should be contacted prior to disposal.

### **.3.9 COMMISSIONING**

- A. Provide commissioning documentation for all inspection, startup, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Following disinfection, water in the tank shall be tested for VOC compliance with state and federal requirements.

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**SECTION 26 05 11**  
**REQUIREMENTS FOR ELECTRICAL INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, and other items and arrangements for the specified items are shown on drawings.
- C. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

**1.2 MINIMUM REQUIREMENTS**

- A. References to the International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

**1.3 TEST STANDARDS**

- A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
  - 1. Listed; Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets

- appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled; Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
  3. Certified; equipment or product which:
    - a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
    - b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
    - c. Bears a label, tag, or other record of certification.
  4. Nationally recognized testing laboratory; laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

#### **1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)**

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

#### **1.5 APPLICABLE PUBLICATIONS**

Applicable publications listed in all Sections of Division are the latest issue, unless otherwise noted.

#### **1.6 MANUFACTURED PRODUCTS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class or type of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  - 1. Components of an assembled unit need not be products of the same manufacturer.
  - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
  - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
  - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COR a minimum of 15 working days prior to the manufacturers making the factory tests.
  - 2. Four copies of certified test reports containing all test data shall be furnished to the COR prior to final inspection and not more than 90 days after completion of the tests.
  - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

#### **1.7 EQUIPMENT REQUIREMENTS**

Where variations from the contract requirements are requested in accordance Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

#### **1.8 EQUIPMENT PROTECTION**

- A. Equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
  - 1. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Equipment shall include but not be limited



- to, enclosures, controllers, circuit protective devices, cables, wire, light fixtures, and accessories.
2. During installation, equipment shall be protected against entry of foreign matter; and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
  3. Damaged equipment shall be, as determined by the COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
  4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
  5. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

#### **1.9 WORK PERFORMANCE**

- A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
  1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
  2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
  3. Before initiating any work, a job specific work plan must be developed by the contractor with a peer review conducted and documented by the COR and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.
  4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the COR.

- D. For work on existing stations, arrange, phase and perform work to assure electrical service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interferences.

#### **1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working spaces shall not be less than specified in the NEC for all voltages specified.
- C. Inaccessible Equipment:
  - 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
  - 2. "Conveniently accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

#### **1.11 EQUIPMENT IDENTIFICATION**

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as, cabinets, fused and unfused safety switches, separately enclosed circuit breakers, individual breakers in panelboards, control devices and other significant equipment.
- B. Nameplates for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Nameplates for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 1/2 inch [12mm] high. Nameplates shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

#### 1.12 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
  - 1. Mark the submittals, "SUBMITTED UNDER SECTION\_\_\_\_\_".
  - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
  - 3. Submit each section separately.
- E. The submittals shall include the following:
  - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
  - 2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
  - 3. Parts list which shall include those replacement parts recommended by the equipment manufacturer.
- F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
  - 1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
  - 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the

- system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
  4. The manuals shall include:
    - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
    - b. A control sequence describing start-up, operation, and shutdown.
    - c. Description of the function of each principal item of equipment.
    - d. Installation instructions.
    - e. Safety precautions for operation and maintenance.
    - f. Diagrams and illustrations.
    - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
    - h. Performance data.
    - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
    - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
  - G. Approvals will be based on complete submission of manuals together with shop drawings.
  - H. After approval and prior to installation, furnish the COR with one sample of each of the following:
    1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
    2. Each type of conduit coupling, bushing and termination fitting.
    3. Conduit hangers, clamps and supports.
    4. Duct sealing compound.
    5. Each type of receptacle, toggle switch, occupancy sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

### **1.13 SINGULAR NUMBER**

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

### **1.14 ACCEPTANCE CHECKS AND TESTS**

The contractor shall furnish the instruments, materials and labor for field tests.

### **1.15 TRAINING**

- A. Training shall be provided in accordance with Article 1.25, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the COR at least 30 days prior to the planned training.

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**SECTION 26 05 21**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW)**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the furnishing, installation, and connection of the low voltage power and lighting wiring.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section.
- B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for cables and wiring.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 FACTORY TESTS**

Low voltage cables shall be thoroughly tested at the factory per NEMA WC-70 to ensure that there are no electrical defects. Factory tests shall be certified.

**1.5 SUBMITTALS**

In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

- 1. Manufacturer's Literature and Data: Showing each cable type and rating.
- 2. Certifications: Two weeks prior to the final inspection, submit four copies of the following certifications to the COR:
  - a. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
  - b. Certification by the contractor that the materials have been properly installed, connected, and tested.

**1.6 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.

- B. American Society of Testing Material (ASTM):
  - D2301-04.....Standard Specification for Vinyl Chloride  
Plastic Pressure-Sensitive Electrical Insulating  
Tape
- C. National Fire Protection Association (NFPA):
  - 70-08.....National Electrical Code (NEC)
- D. National Electrical Manufacturers Association (NEMA):
  - WC 70-09.....Power Cables Rated 2000 Volts or Less for the  
Distribution of Electrical Energy
- E. Underwriters Laboratories, Inc. (UL):
  - 44-05.....Thermoset-Insulated Wires and Cables
  - 83-08.....Thermoplastic-Insulated Wires and Cables
  - 467-071.....Electrical Grounding and Bonding Equipment
  - 486A-486B-03.....Wire Connectors
  - 486C-04.....Splicing Wire Connectors
  - 486D-05.....Sealed Wire Connector Systems
  - 486E-94.....Equipment Wiring Terminals for Use with Aluminum  
and/or Copper Conductors
  - 493-07.....Thermoplastic-Insulated Underground Feeder and  
Branch Circuit Cable
  - 514B-04.....Conduit, Tubing, and Cable Fittings
  - 1479-03.....Fire Tests of Through-Penetration Fire Stops

## **PART 2 - PRODUCTS**

### **2.1 CONDUCTORS AND CABLES**

- A. Conductors and cables shall be in accordance with NEMA WC-70 and as specified herein.
- B. Single Conductor:
  - 1. Shall be annealed copper.
  - 2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.
  - 3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.
- C. Insulation:
  - 1. XHHW-2 or THHN-THWN shall be in accordance with NEMA WC-70, UL 44, and UL 83.
- D. Color Code:
  - 1. Secondary service feeder and branch circuit conductors shall be color-coded as follows:

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

- a. Lighting circuit "switch legs" and 3-way switch "traveling wires" shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC.  
Coordinate color coding in the field with the COR.
2. Use solid color insulation or solid color coating for No. 12 AWG and No. 10 AWG branch circuit phase, neutral, and ground conductors.
3. Conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
  - a. Solid color insulation or solid color coating.
  - b. Stripes, bands, or hash marks of color specified above.
  - c. Color as specified using 0.75 in [19 mm] wide tape. Apply tape in half-overlapping turns for a minimum of 3 in [75 mm] for terminal points, and in junction boxes, pull-boxes, troughs, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.

## 2.2 SPLICES AND JOINTS

- A. In accordance with UL 486A, C, D, E, and NEC.
- B. Aboveground Circuits (No. 10 AWG and smaller):
  1. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220° F [105° C], with integral insulation, approved for copper and aluminum conductors.
  2. The integral insulator shall have a skirt to completely cover the stripped wires.
  3. The number, size, and combination of conductors, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Aboveground Circuits (No. 8 AWG and larger):
  1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.



2. Field-installed compression connectors for cable sizes 250 kcmil and larger shall have not fewer than two clamping elements or compression indents per wire.
3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

D. Underground Branch Circuits and Feeders:

1. Submersible connectors in accordance with UL 486D, rated 600 V, 190° F [90° C], with integral insulation.

**2.3 CONTROL WIRING**

- A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified for power and lighting wiring, except that the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

**2.4 WIRE LUBRICATING COMPOUND**

- A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Install in accordance with the NEC, and as specified.
- B. Install all wiring in raceway systems.
- C. Splice cables and wires only in outlet boxes, junction boxes, pull-boxes, manholes, or handholes.
- D. Wires of different systems (e.g., 120 V, 277 V) shall not be installed in the same conduit or junction box system.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. For panel boards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- G. Seal cable and wire entering a building from underground between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- H. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables. Use lubricants approved for the cable.
  2. Use nonmetallic ropes for pulling feeders.
  3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the COR.
  4. All cables in a single conduit shall be pulled simultaneously.
  5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- I. No more than three single-phase branch circuits shall be installed in any one conduit.

### **3.2 INSTALLATION IN MANHOLES-NOT USED.**

### **3.3 SPLICE INSTALLATION**

- A. Splices and terminations shall be mechanically and electrically secure.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque values.
- C. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

### **3.4 FEEDER IDENTIFICATION**

- A. In each interior pull-box and junction box, install metal tags on all circuit cables and wires to clearly designate their circuit identification and voltage. The tags shall be the embossed brass type, 1.5 in [40 mm] in diameter and 40 mils thick. Attach tags with plastic ties.
- B. In each manhole and handhole, provide tags of the embossed brass type, showing the circuit identification and voltage. The tags shall be the embossed brass type, 1.5 in [40 mm] in diameter and 40 mils thick. Attach tags with plastic ties.

### **3.5 EXISTING WIRING**

Unless specifically indicated on the plans, existing wiring shall not be reused for a new installation.

### **3.6 CONTROL AND SIGNAL WIRING INSTALLATION**

- A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.

- C. Where separate power supply circuits are not shown, connect the systems to the nearest panel boards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.

### **3.7 CONTROL AND SIGNAL SYSTEM WIRING IDENTIFICATION**

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

### **3.9 ACCEPTANCE CHECKS AND TESTS**

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices, such as fixtures, motors, or appliances. Test each conductor with respect to adjacent conductors and to ground. Existing conductors to be reused shall also be tested.
- B. Applied voltage shall be 500VDC for 300-volt rated cable, and 1000VDC for 600-volt rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300-volt rated cable and 100 megohms for 600-volt rated cable.
- C. Perform phase rotation test on all three-phase circuits.
- D. The contractor shall furnish the instruments, materials, and labor for all tests.

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**SECTION 26 05 26**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the general grounding and bonding requirements for electrical equipment and operations to provide a low impedance path for possible ground fault currents.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.
- C. Section 26 24 16, PANELBOARDS: Low voltage panelboards.
- D. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for lightning protection.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
  - 1. Clearly present enough information to determine compliance with drawings and specifications.
  - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR:

1. Certification that the materials and installation are in accordance with the drawings and specifications.
2. Certification by the contractor that the complete installation has been properly installed and tested.

#### **1.5 APPLICABLE PUBLICATIONS**

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

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

B1-07.....Standard Specification for Hard-Drawn Copper Wire

B3-07.....Standard Specification for Soft or Annealed Copper Wire

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

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-1983.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

C2-07.....National Electrical Safety Code

C. National Fire Protection Association (NFPA):

70-08.....National Electrical Code (NEC)

99-2005.....Health Care Facilities

D. Underwriters Laboratories, Inc. (UL):

44-05 .....Thermoset-Insulated Wires and Cables

83-08 .....Thermoplastic-Insulated Wires and Cables

467-07 .....Grounding and Bonding Equipment

486A-486B-03 .....Wire Connectors

### **PART 2 - PRODUCTS**

#### **2.1 GROUNDING AND BONDING CONDUCTORS**

A. Equipment grounding conductors shall be UL 44 or UL 83 insulated stranded copper, except that sizes No. 10 AWG [6 mm<sup>2</sup>] and smaller shall be solid copper. Insulation color shall be continuous green for all

equipment grounding conductors, except that wire sizes No. 4 AWG [25 mm<sup>2</sup>] and larger shall be identified per NEC.

- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes No. 10 AWG [6 mm<sup>2</sup>] and smaller shall be ASTM B1 solid bare copper wire.
- C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

## **2.2 GROUND RODS**

- A. Steel or copper clad steel, 0.75 in [19 mm] diameter by 10 ft [30 M] long, conforming to UL 467.
- B. Quantity of rods shall be as required to obtain the specified ground resistance, as shown on the drawings.

## **2.3 CONCRETE ENCASED ELECTRODE**

Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

## **2.4 MEDIUM VOLTAGE SPLICES AND TERMINATIONS-NOT USED.**

## **2.5 GROUND CONNECTIONS**

- A. Below Grade: Exothermic-welded type connectors.
- B. Above Grade:
  - 1. Bonding Jumpers: Compression-type connectors, using zinc-plated fasteners and external tooth lockwashers.
  - 2. Connection to Building Steel: Exothermic-welded type connectors.
  - 3. Ground Busbars: Two-hole compression type lugs, using tin-plated copper or copper alloy bolts and nuts.
  - 4. Rack and Cabinet Ground Bars: One-hole compression-type lugs, using zinc-plated or copper alloy fasteners.

## **2.6 EQUIPMENT RACK AND CABINET GROUND BARS**

Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 0.375 in [4 mm] thick x 0.75 in [19 mm] wide.

## **2.7 GROUND TERMINAL BLOCKS**

At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

## **2.8 GROUNDING BUS**

Pre-drilled rectangular copper bar with stand-off insulators, minimum 0.25 in [6.3 mm] thick x 4 in [100 mm] high in cross-section, length as shown on drawings, with 0.281 in [7.1 mm] holes spaced 1.125 in [28 mm] apart.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

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

### **3.2 INACCESSIBLE GROUNDING CONNECTIONS**

Make grounding connections, which are normally buried or otherwise inaccessible (except connections for which access for periodic testing is required), by exothermic weld.

### **3.3 MEDIUM VOLTAGE EQUIPMENT AND CIRCUITS**

- A. Switchgear: **Not Used.**
- B. Duct Banks and Manholes: **Not Used.**
- C. Pad-Mounted Transformers:
  - 1. Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad.
  - 2. Ground the secondary neutral.
- D. Lightning Arresters: Connect lightning arresters to the equipment ground bus or ground rods as applicable.

### **3.4 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS**

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
  - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building steel, and supplemental or made electrodes. Provide jumper

- insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
2. Provide a supplemental ground electrode and bond to the grounding electrode system.
- C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.
- D. Transformers:
1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
  2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system

### **3.5 RACEWAY**

- A. Conduit Systems:
1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
  2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
  3. Conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
  4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a bare grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).



2. Provide lugs in each box and enclosure for equipment grounding conductor termination.

D. Wireway Systems: **Not Used.**

- E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

- F. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

- G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

**3.6 OUTDOOR METALLIC FENCES AROUND ELECTRICAL EQUIPMENT: NOT USED.**

**3.7 CORROSION INHIBITORS**

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

**3.8 CONDUCTIVE PIPING**

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

**3.9 LIGHTNING PROTECTION SYSTEM**

Bond the lightning protection system to the electrical grounding electrode system.

**3.10 GROUND RESISTANCE**

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry

conditions not fewer than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- C. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Below-grade connections shall be visually inspected by the COR prior to backfilling. The contractor shall notify the COR 24 hours before the connections are ready for inspection.

### **3.11 GROUND ROD INSTALLATION**

- A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 24 in [609 mm] below final grade.
- B. For indoor installations, leave 4 in [100 mm] of rod exposed.
- C. Where permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.
- D. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

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**SECTION 26 05 33**  
**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

- A. Manufacturer's Literature and Data: Showing each cable type and rating. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Shop Drawings:
  - 1. Size and location of main feeders.
  - 2. Size and location of panels and pull-boxes.
  - 3. Layout of required conduit penetrations through structural elements.
- C. Certifications:
  - 1. Two weeks prior to the final inspection, submit four copies of the following certifications to the COR:
    - a. Certification by the manufacturer that the material conforms to the requirements of the drawings and specifications.
    - b. Certification by the contractor that the material has been properly installed.

## 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American National Standards Institute (ANSI):
- C80.1-05.....Electrical Rigid Steel Conduit
  - C80.6-05.....Electrical Intermediate Metal Conduit
- C. National Fire Protection Association (NFPA):
- 70-08.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
- 1-05.....Flexible Metal Conduit
  - 5-04.....Surface Metal Raceway and Fittings
  - 6-07.....Electrical Rigid Metal Conduit - Steel
  - 50-95.....Enclosures for Electrical Equipment
  - 360-093.....Liquid-Tight Flexible Steel Conduit
  - 467-07.....Grounding and Bonding Equipment
  - 514A-04.....Metallic Outlet Boxes
  - 514B-04.....Conduit, Tubing, and Cable Fittings
  - 514C-96.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
  - 651-05.....Schedule 40 and 80 Rigid PVC Conduit and Fittings
  - 651A-00.....Type EB and A Rigid PVC Conduit and HDPE Conduit
  - 1242-06.....Electrical Intermediate Metal Conduit - Steel
- E. National Electrical Manufacturers Association (NEMA):
- TC-2-03.....Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
  - TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and Tubing
  - FB1-07.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

## PART 2 - PRODUCTS

### 2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 0.5 in unless otherwise shown. Where permitted by the NEC, 0.5 in flexible conduit may be used for tap connections to recessed lighting fixtures.
- B. Conduit:
1. Rigid steel: Shall conform to UL 6 and ANSI C80.1.
  2. Rigid intermediate steel conduit (IMC): Shall conform to UL 1242 and ANSI C80.6.

3. Flexible galvanized steel conduit: Shall conform to UL 1.
4. Liquid-tight flexible metal conduit: Shall conform to UL 360.
5. Surface metal raceway: Shall conform to UL 5.

C. Conduit Fittings:

1. Rigid steel and IMC conduit fittings:
  - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
  - b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
  - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
  - d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
  - e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
  - f. Sealing fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Flexible steel conduit fittings:
  - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
  - b. Clamp-type, with insulated throat.
3. Liquid-tight flexible metal conduit fittings:
  - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
4. Surface metal raceway fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
5. Expansion and deflection couplings:

- a. Conform to UL 467 and UL 514B.
  - b. Accommodate a 0.75 in deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
  - c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.
  - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
- 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
  - 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
  - 3. Multiple conduit (trapeze) hangers: Not less than 1.5 x 1.5 in, 12-gauge steel, cold-formed, lipped channels; with not less than 0.375 in diameter steel hanger rods.
  - 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
- 1. UL-50 and UL-514A.
  - 2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
  - 3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
  - 4. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

### **PART 3 - EXECUTION**

#### **3.1 PENETRATIONS**

- A. Cutting or Holes:
- 1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the COR prior to drilling through structural elements.

2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except where permitted by the COR as required by limited working space.
- B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight.

### **3.2 INSTALLATION, GENERAL**

- A. In accordance with UL, NEC, as shown, and as specified herein.
- B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where shown on drawings.
- C. Install conduit as follows:
  1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
  2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
  3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
  4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
  5. Cut square, ream, remove burrs, and draw up tight.
  6. Independently support conduit at 8 ft on centers. Do not use other supports, i.e., suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts.
  7. Support within 12 in of changes of direction, and within 12 in of each enclosure to which connected.
  8. Close ends of empty conduit with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
  9. Conduit installations under fume and vent hoods are prohibited.
  10. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
  11. Conduit bodies shall only be used for changes in direction, and shall not contain splices.

D. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown on drawings.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COR.

**3.3 CONCEALED WORK INSTALLATION**

A. Above Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors 600 V and below: Rigid steel or IMC. Mixing different types of conduits indiscriminately in the same system is prohibited.
2. Align and run conduit parallel or perpendicular to the building lines.
3. Connect recessed lighting fixtures to conduit runs with maximum 6 ft of flexible metal conduit extending from a junction box to the fixture.
4. Tightening set screws with pliers is prohibited.

**3.4 EXPOSED WORK INSTALLATION**

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors 600 V and Below: Rigid steel or IMC. Mixing different types of conduits indiscriminately in the system is prohibited.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 8 ft intervals.
- F. Surface metal raceways: Use only where shown.

**3.5 WET OR DAMP LOCATIONS**

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



### **3.6 MOTORS AND VIBRATING EQUIPMENT**

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Use liquid-tight flexible metal conduit for installation in, moisture or humidity laden atmosphere, and locations subject to seepage or dripping of water. Provide a green equipment grounding conductor with flexible metal conduit.

### **3.7 CONDUIT SUPPORTS, INSTALLATION**

- A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 200 lbs. Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
  - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
  - 2. Existing Construction:
    - a. Steel expansion anchors not less than 0.25 in bolt size and not less than 1.125 in embedment.
    - b. Power set fasteners not less than 0.25 in diameter with depth of penetration not less than 3 in.
    - c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.
- E. Hollow Masonry: Toggle bolts.
- F. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- G. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- H. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- I. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- J. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.

- K. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

### **3.11 BOX INSTALLATION**

- A. Boxes for Concealed Conduits:
  - 1. Flush-mounted.
  - 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 24 in center-to-center lateral spacing shall be maintained between boxes.
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 4 in square x 2.125 in deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."
- G. On all branch circuit junction box covers, identify the circuits with black marker.

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**SECTION 26 24 16**  
**PANELBOARDS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the furnishing, installation, and connection of panelboards.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one Section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
  - 1. Sufficient information, shall be clearly presented to determine compliance with drawings and specifications.
  - 2. Include electrical ratings, dimensions, mounting details, materials, wiring diagrams, accessories, and weights of equipment. Complete nameplate data, including manufacturer's name and catalog number.
- C. Manuals:
  - 1. When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals, including technical data sheets and wiring diagrams.
  - 2. If changes have been made to the maintenance and operating manuals that were originally submitted, then submit four copies of updated

maintenance and operating manuals to the COR two weeks prior to final inspection.

D. Certification: Two weeks prior to final inspection, submit four copies of the following to the COR:

1. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
2. Certification by the contractor that the materials have been properly installed, connected, and tested.

### **1.5 APPLICABLE PUBLICATIONS**

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Electrical Manufacturers Association (NEMA):

PB-1-06.....Panelboards

250-08.....Enclosures for Electrical Equipment (1000V  
Maximum)

C. National Fire Protection Association (NFPA):

70-2005 .....National Electrical Code (NEC)

70E-2004.....Standard for Electrical Life Safety in the  
Workplace

D. Underwriters Laboratories, Inc. (UL):

50-95.....Enclosures for Electrical Equipment

67-09.....Panelboards

489-09.....Molded Case Circuit Breakers and Circuit  
Breaker Enclosures

## **PART 2 - PRODUCTS**

### **2.1 PANELBOARDS**

A. Panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.

B. Panelboards shall be standard manufactured products.

C. All panelboards shall be hinged "door in door" type with:

1. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
2. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand-operated latches are not acceptable.

3. Push inner and outer doors shall open left to right.
- D. All panelboards shall be completely factory-assembled with molded case circuit breakers. Include one-piece removable, inner dead front cover, independent of the panelboard cover.
- E. Panelboards shall have main breaker or main lugs, bus size, voltage, phase, top or bottom feed, and flush or surface mounting as scheduled on the drawings.
- F. Panelboards shall conform to NEMA PB-1, NEMA AB-1, and UL 67 and have the following features:
  1. Non-reduced size copper bus bars with current ratings as shown on the panel schedules, rigidly supported on molded insulators.
  2. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
  3. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys of sizes suitable for the conductors to which they will be connected.
  4. Neutral bus shall be 100% rated, mounted on insulated supports.
  5. Grounding bus bar shall be equipped with screws or lugs for the connection of grounding wires.
  6. Buses shall be braced for the available short-circuit current. Bracing shall not be less than 22,000 A symmetrical for 120/208 V and 120/240 V panelboard. Branch circuit panelboards shall have buses fabricated for bolt-on type circuit breakers.
  8. Protective devices shall be designed so that they can easily be replaced.
  9. Where designated on panel schedule "spaces," include all necessary bussing, device support, and connections. Provide blank cover for each space.
  10. Series-rated panelboards are not permitted.

## **2.2 CABINETS AND TRIMS**

### **Cabinets:**

1. Provide galvanized steel cabinets to house panelboards. Cabinets for outdoor panelboards shall be factory primed and suitably treated with a corrosion-resisting paint finish meeting UL 50 and UL 67.
2. Cabinet enclosure shall not have ventilating openings.
3. Cabinets for panelboards may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.

### **2.3 MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS**

- A. Circuit breakers shall be per UL 489, in accordance with the NEC, as shown on the drawings, and as specified.
- B. Circuit breakers in panelboards shall be bolt-on type.
- C. Molded case circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
  - 1. 120/208 V Panelboard: 10,000 A symmetrical.
  - 2. 120/240 V Panelboard: 10,000 A symmetrical.
  - 3. 277/480 V Panelboard: 14,000 A symmetrical.
- D. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 A frame or lower. Magnetic trip shall be adjustable from 3x to 10x for breakers with 600 A frames and higher.
- E. Breaker features shall be as follows:
  - 1. A rugged, integral housing of molded insulating material.
  - 2. Silver alloy contacts.
  - 3. Arc quenchers and phase barriers for each pole.
  - 4. Quick-make, quick-break, operating mechanisms.
  - 5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
  - 6. Electrically and mechanically trip free.
  - 7. An operating handle which indicates ON, TRIPPED, and OFF positions.
  - 8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
  - 9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where indicated.
  - 10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory accordingly.

### **2.4 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS**

- A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.

- B. Enclosures are to be of the NEMA types shown on the drawings. Where the types are not shown, they are to be the NEMA type most suitable for the environmental conditions where the circuit breakers are being installed.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- C. Install a printed schedule of circuits in each panelboard after approval by the COR. Schedules shall be printed on the panelboard directory cards, installed in the appropriate panelboards, and incorporate all applicable contract changes. Information shall indicate outlets, lights, devices, or other equipment controlled by each circuit, and the final room numbers served by each circuit.
- D. Mount the fully-aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78 in [1980 mm]. Mount panelboards that are too high such that the bottom of the cabinets will not be less than 6 in [150 mm] above the finished floor.
- E. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims, doors, and boxes with finishes to match surrounding surfaces after the panelboards have been installed.
- F. Rust and scale shall be removed from the inside of existing backboxes where new panelboards are to be installed. Paint inside of backboxes with rust-preventive paint before the new panelboard interior is installed. Provide new trim and doors for these panelboards. Covers shall fit tight to the box with no gaps between the cover and the box.

#### **3.2 ACCEPTANCE CHECKS AND TESTS**

Perform in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections and electrical tests:

##### **1. Visual and Mechanical Inspection**

- a. Compare equipment nameplate data with specifications and approved shop drawings.
- b. Inspect physical, electrical, and mechanical condition.
- c. Verify appropriate anchorage and required area clearances.

- d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
- e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
- f. Clean panelboard.

### **3.3 FOLLOW-UP VERIFICATION**

Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

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**SECTION 26 27 26**  
**WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

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

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlets boxes.
- C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include electrical ratings, dimensions, mounting details, construction materials, grade and termination information.
- C. Manuals: Two weeks prior to final inspection, deliver four copies of the following to the COR: Technical data sheets and information for ordering replacement units.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR: Certification by the Contractor that the devices comply with the drawings and specifications, and have been properly installed, aligned, and tested.

**1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

- B. National Fire Protection Association (NFPA):
  - 70.....National Electrical Code (NEC)
- C. National Electrical Manufacturers Association (NEMA):
  - WD 1.....General Color Requirements for Wiring Devices
  - WD 6 .....Wiring Devices - Dimensional Requirements
- D. Underwriter's Laboratories, Inc. (UL):
  - 5.....Surface Metal Raceways and Fittings
  - 20.....General-Use Snap Switches
  - 231.....Power Outlets
  - 467.....Grounding and Bonding Equipment
  - 498.....Attachment Plugs and Receptacles
  - 943.....Ground-Fault Circuit-Interrupters

## **PART 2 - PRODUCTS**

### **2.1 RECEPTACLES**

- A. General: All receptacles shall be listed by Underwriters Laboratories, Inc., and conform to NEMA WD 6.
  - 1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
  - 2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four min.) and side wiring from four captively held binding screws.
- B. Duplex Receptacles: Hospital-grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, and conform to the NEMA 5-20R configuration in NEMA WD 6. The duplex type shall have break-off feature for two-circuit operation. The ungrounded pole of each receptacle shall be provided with a separate terminal.
  - 1. Bodies shall be ivory in color.
  - 2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The remaining receptacle shall be unswitched.
  - 3. Duplex Receptacles on Emergency Circuit:
    - a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.
  - 4. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, hospital-grade, suitable for mounting in a standard outlet box.
    - a. Ground fault interrupter shall be consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of five milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or - 1 milliamp) on the load

side of the device. Device shall have a minimum nominal tripping time of 1/30th of a second.

- b. Ground Fault Interrupter Duplex Receptacles (not hospital-grade) shall be the same as ground fault interrupter hospital-grade receptacles except for the "hospital-grade" listing.

5. Safety Type Duplex Receptacles:

- a. Bodies shall be gray in color.

- 1) Shall permit current to flow only while a standard plug is in the proper position in the receptacle.
- 2) Screws exposed while the wall plates are in place shall be the tamperproof type.

6. Duplex Receptacles (not hospital grade): Shall be the same as hospital grade duplex receptacles except for the "hospital grade" listing and as follows.

- a. Bodies shall be brown phenolic compound supported by a plated steel mounting strap having plaster ears.

C. Receptacles; 20, 30 and 50 ampere, 250 volts: Shall be complete with appropriate cord grip plug. Devices shall meet UL 231.

D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

## 2.2 TOGGLE SWITCHES

A. Toggle Switches: Shall be totally enclosed tumbler type with bodies of phenolic compound. Toggle handles shall be ivory in color unless otherwise specified. The rocker type switch is not acceptable and will not be approved.

- 1. Switches installed in hazardous areas shall be explosion proof type in accordance with the NEC and as shown on the drawings.
- 2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.

3. Ratings:

- a. 120 volt circuits: 20 amperes at 120-277 volts AC.

## **2.3 WALL PLATES**

- A. Wall plates for switches and receptacles shall be type smooth nylon. Oversize plates are not acceptable.
- B. Color shall be ivory unless otherwise specified.
- C. Standard NEMA design, so that products of different manufacturers will be interchangeable. Dimensions for openings in wall plates shall be accordance with NEMA WD 6.
- D. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- E. In psychiatric areas, wall plates shall be 302 stainless steel, have tamperproof screws and beveled edges.
- F. Wall plates for data, telephone or other communication outlets shall be as specified in the associated specification.

## **2.4 SURFACE MULTIPLE-OUTLET ASSEMBLIES**

- A. Assemblies shall conform to the requirements of NFPA 70 and UL 5.
- B. Shall have the following features:
  - 1. Enclosures:
    - a. Thickness of steel shall be not less than 0.040 inch steel for base and cover. Nominal dimension shall be 1-1/2 by 2-3/4 inches with inside cross sectional area not less than 3.5 square inches. The enclosures shall be thoroughly cleaned, phosphatized and painted at the factory with primer and the manufacturer's standard baked enamel or lacquer finish.
  - 2. Receptacles shall be duplex, hospital grade. See paragraph 'RECEPTACLES' in this section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.
  - 3. Unless otherwise shown on drawings, spacing of the receptacles along the strip shall be 24 inches on centers.
  - 4. Wires within the assemblies shall be not less than No. 12 AWG copper, with 600 volt ratings.
  - 5. Installation fittings shall be designed for the strips being installed including bends, offsets, device brackets, inside couplings, wire clips, and elbows.
  - 6. Bond the strips to the conduit systems for their branch supply circuits.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.

- B. Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the green equipment grounding conductor.
- C. Outlet boxes for light switches shall be mounted on the strike side of doors.
- D. Provide barriers in multigang outlet boxes to separate systems of different voltages, Normal Power and Emergency Power systems, and in compliance with the NEC.
- E. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
- F. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades. In addition, check for exact direction of door swings so that local switches are properly located on the strike side.
- G. Install wall switches 48 inches above floor, OFF position down.
- H. Install convenience receptacles 18 inches above floor, and 6 inches above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- I. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.
- J. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
- K. Test GFCI devices for tripping values specified in UL 1436 and UL 943.

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**SECTION 26 29 21**  
**DISCONNECT SWITCHES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the furnishing, installation, and connection of low voltage disconnect switches.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES 600 VOLTS AND BELOW: Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for cables and wiring.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
  - 1. Clearly present sufficient information to determine compliance with drawings and specifications.
  - 2. Include electrical ratings, dimensions, mounting details, materials, enclosure types, and fuse types and classes.
  - 3. Show the specific switch and fuse proposed for each specific piece of equipment or circuit.
- C. Manuals:
  - 1. Provide complete maintenance and operating manuals for disconnect switches, including technical data sheets, wiring diagrams, and information for ordering replacement parts. Deliver four copies to the COR two weeks prior to final inspection.
  - 2. Terminals on wiring diagrams shall be identified to facilitate maintenance and operation.
  - 3. Wiring diagrams shall indicate internal wiring and any interlocking.
- D. Certifications: Two weeks prior to the final inspection, submit four copies of the following certifications to the COR:

1. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
2. Certification by the contractor that the materials have been properly installed, connected, and tested.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. National Electrical Manufacturers Association (NEMA):
  - FU 1-07.....Low Voltage Cartridge Fuses
  - KS 1-06.....Enclosed and Miscellaneous Distribution  
Equipment Switches (600 Volts Maximum)
- C. National Fire Protection Association (NFPA):
  - 70-08.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
  - 98-04.....Enclosed and Dead-Front Switches
  - 248-00.....Low Voltage Fuses
  - 977-94.....Fused Power-Circuit Devices

### **PART 2 - PRODUCTS**

#### **2.1 LOW VOLTAGE FUSIBLE SWITCHES RATED 600 AMPERES AND LESS**

- A. In accordance with UL 98, NEMA KS1, and NEC.
- B. Shall have NEMA classification General Duty (GD) for 240 V switches and NEMA classification Heavy Duty (HD) for 480 V switches.
- C. Shall be HP rated.
- D. Shall have the following features:
  1. Switch mechanism shall be the quick-make, quick-break type.
  2. Copper blades, visible in the OFF position.
  3. An arc chute for each pole.
  4. External operating handle shall indicate ON and OFF position and have lock-open padlocking provisions.
  5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable to permit inspection.
  6. Fuse holders for the sizes and types of fuses specified.
  7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
  8. Ground lugs for each ground conductor.
  9. Enclosures:
    - a. Shall be the NEMA types shown on the drawings for the switches.
    - b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental

conditions. Unless otherwise indicated on the plans, all outdoor switches shall be NEMA 3R.

- c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel (for the type of enclosure required).

## **2.2 LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS**

Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, but without provisions for fuses.

## **2.3 LOW VOLTAGE CARTRIDGE FUSES**

- A. In accordance with NEMA FU1.
- C. Feeders: Class RK5, time delay.
- D. Motor Branch Circuits: Class RK5, time delay.
- E. Other Branch Circuits: Class RK5, time delay.
- F. Control Circuits: Class CC, fast acting.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Install disconnect switches in accordance with the NEC and as shown on the drawings.
- B. Fusible disconnect switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuse.

## **3.2 SPARE PARTS**

Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fusible disconnect switch installed on the project. Deliver the spare fuses to the COR.

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**SECTION 26 41 00**  
**FACILITY LIGHTNING PROTECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the furnishing and installation of a complete master labeled lightning protection system, complying with NFPA 780, UL 96 and UL 96A.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground faults.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
  - 1. Isometric and plan views showing layout and connections to the required metal surfaces.
  - 2. Show the methods of mounting the system to the adjacent construction.
- C. Qualifications: Submit proof that the installer of the lightning protection system is a certified Lighting Protection Institute (LPI) installer, and has had suitable and adequate experience installing other lightning protection systems, and is capable of installing the system as recommended by the manufacturer of the equipment.
- D. Certification: Two weeks prior to final inspection, submit four copies of the following certifications to the COR:
  - 1. Certification that the lightning protection system has been properly installed and tested.
  - 2. Certification that the lightning protection system has been inspected by a UL representative and has been approved by UL without variation.

## 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. National Fire Protection Association (NFPA):
  - 70.....National Electrical Code (NEC)
  - 780.....Standard for the Installation of Lightning Protection Systems
- C. Underwriters Laboratories, Inc. (UL):
  - 96.....Lightning Protection Components
  - 96A.....Installation Requirements for Lightning Protection Systems
  - UL 467 .....Standard for Grounding and Bonding Equipment

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Attach master labels to each item by its manufacturer as evidence that the materials have been manufactured in conformance with the UL Standards for master label lightning protection materials.
- B. In addition to conformance to UL 96, the component material requirements are as follows:
  - 1. Conductors: Electrical grade copper. Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, Class II, or Class II modified materials as applicable.
  - 2. Air terminals: Solid copper, 18 inches long, not less than 3/8 inch [9mm] diameter, with sharp nickel-plated points.
  - 3. Ground rods: Copper clad steel, not less than 1/2 inch [13mm] diameter by 8 feet [2400mm] long. Rods made of copper-clad steel shall conform to UL 467 and galvanized ferrous rods shall conform to IEEE C135.30. Ground rods of copper-clad steel, steel, stainless steel, galvanized ferrous, and solid copper shall not be mixed on the project.
  - 4. Ground plates: Solid copper, not less than 1/16 inch [2mm] thick.
  - 5. Tubing: Stiff copper or brass.
- C. Anchors and fasteners: Bolt type which are most suitable for the specific anchor and fastener installations. Clamp-type connectors for splicing conductors shall conform to UL 96, class as applicable, and, Class 2, style and size as required for the installation. Clamp-type connectors shall only be used for the connection of the roof conductor to the air terminal and to the guttering. All other connections, bonds, and splices shall be done by exothermic welds or by high compression fittings. The exothermic welds and high compression fittings shall be

listed for the purpose. The high compression fittings shall be the type which require a hydraulically operated mechanism to apply a minimum of 10,000 psi.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be coordinated with the roofing manufacturer and installer.
- B. Install the conductors as inconspicuously as practical and with the proper bends.
- C. Install the vertical conductors within the concealed cavity of exterior walls. Run the conductors to the exterior at elevations below the finished grade and make the ground connections to the earth outside of the building or stack perimeter.
- D. Make connections of dissimilar metal with bimetallic type fittings to prevent electrolytic action.
- E. Use the exothermic welding type connections that form solid metal joints in the main vertical and horizontal conductors, and for connections that are not exposed in the finish work.
- F. Protect copper conductors with stiff copper or brass tubing, which enclose the conductors from the top to the bottom of the tubing, between one foot [300mm] below and seven feet [2100mm] above the finished grade. The conductor shall be bonded to the top and bottom of the tubing.
- G. Sheath copper conductors, which pass over cast stone, cut stone, architectural concrete and masonry surfaces, with not less than a 1/16 inch [2mm] thickness of lead to prevent staining of the exterior finish surfaces.
- H. For the earth connections, install ground rods and ground plates, and the conductor connections to them and the main water pipes in the presence of the COR. For the conductors located outside of the building or stack, install the conductors not less than two feet [600mm] below the finished grade.
- I. For structural steel buildings, connect the steel framework of the buildings to the main water pipe near the water system entrance to the building.
- J. Connect lightning protection cables to all metallic projections, equipment, and components above the roof as indicated on the drawings.
- K. Connect exterior metal surfaces, located within three feet [900mm] of the lightning protection system conductors, to the lightning protection system conductors to prevent flashovers.

- L. Maintain horizontal or downward coursing of main conductor and insure that all bends have at least an 8-inch radius and do not exceed 90 degrees.
- M. Conductors shall be rigidly fastened every three feet [900mm] along the roof and down to the building to ground.
- N. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure. Install air terminal bases, cable holders and other roof-system supporting means without piercing roof metal.
- P. Use through-roof connectors for down-conductor attachment to roof system.
- Q. Down-conductors coursed on or in reinforced concrete columns or on structural steel columns shall be connected to the reinforcing steel or the structural steel member at its upper and lower extremities. In the case of long vertical members an additional connection shall be made at intervals not exceeding 100 feet [30m].
- R. A counterpoise, where shown, shall be of No. 1/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 2 feet [600mm] deep at a distance not less than 3 feet [900mm] nor more than 8 feet [2.5m] from the nearest point of the structure.
- S. On construction utilizing post tensioning systems to secure precast concrete sections, the post tension rods shall not be used as a path for lightning to ground. Down conductors shall be provided on structures using post tensioning systems. Down conductors shall have sufficient separation from post tension rods to prevent side-flashing. Post tension rods shall be bonded to the lightning protection and grounding systems only at the base of the structure; this bonding shall be performed in strict accordance with the recommendations of the post tension rod manufacturer, and shall be done by, or in the presence of, a representative of the manufacturer.
- T. Grounding: Test the ground resistance to earth by standard methods and conform to the ground resistance requirements specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- U. Where shown, use the structural steel framework or reinforcing steel as the main conductor:
  - 1. Weld or bond the non-electrically-continuous sections together and make them electrically continuous.
  - 2. Verify the electrical continuity by measuring the ground resistances to earth at the ground level, at the top of the building or stack,

- and at intermediate points with a sensitive ohmmeter. Compare the resistance readings.
3. Connect the air terminals together with an exterior conductor connected to the structural steel framework at not more than 60 foot [18m] intervals.
  4. Install ground connections to earth at not more than 60 foot [18m] intervals around the perimeter of the building.
  5. Weld or braze bonding plates, not less than 8 inches [200mm] square, to cleaned sections of the steel and connect the conductors to the plates.
  6. Do not pierce the structural steel in any manner. Connections to the structural steel shall conform to UL Publication No. 96A.
- V. For obstruction lights, the following additional requirements shall apply:
1. Extend air terminals one foot [300mm] above the top of the light fixtures and securely clamp to the light fixture supports.
  2. Install 600 volt class lightning arresters. Connect the arresters to the lightning circuit conductors at suitable locations, and ground and bond them to the lightning protection system.
- W. When the lightning protection systems have been installed, have the systems inspected by a UL representative. Obtain and install a UL numbered master label for each of the lightning protection systems at the location directed by the UL representative and the COR.

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**SECTION 31 20 00**  
**EARTH MOVING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK:**

- A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:
1. Site preparation.
  2. Excavation.
  3. Underpinning.
  4. Filling and backfilling.
  5. Grading.
  6. Soil Disposal.
  7. Clean Up.

**1.2 DEFINITIONS:**

- A. Unsuitable Materials:
1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 3 inches; organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D 698 D 1557 AASHTO T 99 T 180.
  2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
  3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to Contracting Officer's Representative's (COR) approval.
- B. Building Earthwork: Earthwork operations required in area enclosed by a line located 5 feet outside of principal building perimeter. It also includes earthwork required for auxiliary structures and buildings.
- C. Trench Earthwork: Trenchwork required for utility lines.
- D. Site Earthwork: Earthwork operations required in area outside of a line located 5 feet outside of principal building perimeter and within new construction area with exceptions noted above.

- E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through use of data provided from results of field test procedures presented in ASTM D1556, ASTM D2167, and ASTM D2922.
- F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term "fill" means fill or backfill as appropriate.
- G. Backfill: Soil materials or controlled low strength material used to fill an excavation.
- H. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization by the COR. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.
- I. Authorized additional excavation: Removal of additional material authorized by the COR based on the determination by the Government's soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.
- J. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.
- K. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- N. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe. Bedding course shall extend up to the springline of the pipe.
- O. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.
- P. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- Q. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building

materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.

- R. Contaminated soils: Soil that contains contaminants as defined and determined by the COR or the Government's testing agency.

**1.3 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.
- D. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- E. Site preparation: Section 31 23 19, DEWATERING, and Section 02 41 00, DEMOLITION. F. Paving sub-grade requirements: Section 32 12 16, ASPHALT PAVING.

**1.4 CLASSIFICATION OF EXCAVATION:**

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.
- B. Classified Excavation: Removal and disposal of all material except that material not defined as Rock.
- C. Rock Excavation:
  - 1. Trenches and Pits: Removal and disposal of solid, homogenous, interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be excavated with a late-model, track-mounted hydraulic excavator; equipped with a 42 inch wide, short-tip-radius rock bucket; rated at not less than 138 hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 19,000 lbf; measured according to SAE J-1179. Trenches in excess of 10 feet wide and pits in excess of 30 feet in either length or width are classified as open excavation.
  - 2. Open Excavation: Removal and disposal of solid, homogenous, interlocking crystalline material firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be dislodged and excavated with a late-model, track-mounted loader; rated at not less



- than 210 hp flywheel power and developing a minimum of 48,510 lbf breakout force; measured according to SAE J-732.
3. Other types of materials classified as rock are unstratified masses, conglomerated deposits and boulders of rock material exceeding 1 cubic yard for open excavation, or 3/4 cubic yard for footing and trench excavation that cannot be removed by rock excavating equipment equivalent to the above in size and performance ratings, without systematic drilling, ram hammering, or ripping, when permitted.
  4. Definitions of rock and guidelines for equipment are presented for general information purposes only. The Contractor is expected to use the information presented in the Geotechnical Engineering Report to evaluate the extent and competency of the rock and to determine both quantity estimations and removal equipment and efforts.

**1.5 MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION:**

- A. Measurement: Cross section and measure uncovered and separated materials, and compute quantities by Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS. Do not measure quantities beyond the following limits:
  1. 24 inches from outside face of concrete work for which forms are required, except for footings.
  2. 12 inches from outside of perimeter of formed footings.
  3. 6 inches below bottom of pipe and not more than pipe diameter plus 24 inches in width for pipe trenches.
  4. From outside dimensions of concrete work for which no forms are required (trenches, conduits, and similar items not requiring forms).
- B. Payment for rock excavation shall be in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

**1.6 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Rock Excavation Report:
  1. Certification of rock quantities excavated.
  2. Excavation method.
  3. Labor.
  4. Equipment.
  5. Land Surveyor's or Civil Engineer's name and official registration stamp.
  6. Plot plan showing elevation.
- C. Furnish to COR:

1. Contactor shall furnish resumes with all personnel involved in the project including Project Manager, Superintendent, and on-site Engineer. Project Manager and Superintendent should have at least 3 years of experience on projects of similar size.
2. Soil samples.
  - a. Classification in accordance with ASTM D2487 for each on-site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
  - b. Laboratory compaction curve in accordance with ASTM D 698 D 1557 AASHTO T 99 T 180 for each on site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
  - c. Test reports for compliance with ASTM D 2940 requirements for subbase material.
  - d. Pre-excavation photographs and videotape in the vicinity of the existing structures to document existing site features, including surfaces finishes, cracks, or other structural blemishes that might be misconstrued as damage caused by earthwork operations.
  - e. The Contractor shall submit a scale plan daily that defines the location, limits, and depths of the area excavated.

**1.7 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
  - T99-01(2004).....Moisture-Density Relations of Soils Using a 5.5 lb Rammer and a 12 inch Drop
  - T180-01(2004).....Moisture-Density Relations of Soils using a 10 lb Rammer and a 18 inch Drop
- C. American Society for Testing and Materials (ASTM):
  - D448-03a.....Standard Classification for Sizes of Aggregate for Road and Bridge Construction
  - D698-00ae1.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft<sup>3</sup>)
  - D1556-00.....Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
  - D1557-02e1.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>)

D2167-94 (2001).....Standard Test Method for Density and Unit Weight  
of Soil in Place by the Rubber Balloon Method  
D2487-06.....Standard Classification of Soil for Engineering  
Purposes (Unified Soil Classification System)  
D2922-05.....Standard Test Methods for Density of Soil and  
Soil-Aggregate in Place by Nuclear Methods  
(Shallow Depth)  
D2940-03.....Standard Specifications for Graded Aggregate  
Material for Bases or Subbases for Highways or  
Airports

D. Society of Automotive Engineers (SAE):

J732-92.....Specification Definitions - Loaders

J1179-02.....Hydraulic Excavator and Backhoe Digging Forces

**PART 2 - PRODUCTS**

**2.1 MATERIALS:**

- A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.
- B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off site sources having a minimum dry density of 110 pcf, a maximum Plasticity Index of 15, and a maximum Liquid Limit of 40.
- C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups, or as approved by the Engineer or material with at least 90 percent passing a 1 1/2-inch sieve and not more than 12 percent passing a No. 200 sieve, per ASTM D2940;.
- D. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 1 inch sieve and not more than 8 percent passing a No. 200 sieve.
- E. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1 1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- F. Granular Fill:
  - 1. Under concrete slab, crushed stone or gravel graded from 1 inch to No. 4, per ASTM D 2940.

2. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 1/2 inch to No 4, per ASTM D 2940.

### **PART 3 - EXECUTION**

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

- A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions. Remove materials from Medical Center.
- B. Grubbing: Remove stumps and roots 3 inch and larger diameter. Undisturbed sound stumps, roots up to 3 inch diameter, and nonperishable solid objects a minimum of 3 feet below subgrade or finished embankment may be left.
- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from areas within 15 feet of new construction and 7.5 feet of utility lines when removal is approved in advance by COR. Remove materials from Medical Center. Trees and shrubs, shown to be transplanted, shall be dug with a ball of earth and burlapped in accordance with latest issue of, "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 semiannually 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 conclusion of contract. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Do not store building materials closer to trees and shrubs, that are to remain, than farthest extension of their limbs.
- D. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by COR. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 1/2 cubic foot in volume, from soil as it is stockpiled. Retain topsoil on station. Remove foreign materials larger

than 2 inches in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the soil will be destroyed.

- E. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 12 inches on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from Medical Center.
- F. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.
1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
  2. Locations of existing and any proposed elevations indicated on plans, are approximated from a site survey that measured spot elevations and subsequently generated existing contours and spot elevations. Any Proposed spot elevations and contour lines have been developed utilizing the existing conditions survey and developed contour lines and may be approximate. Contractor is responsible to notify COR of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify COR of any differences between existing or constructed grades, as compared to those shown on the plans.
  3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.
- G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

### **3.2 EXCAVATION:**

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the COR, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.
1. Design of the temporary support of excavation system is the responsibility of the Contractor.
  2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the COR.
  3. Extend shoring and bracing to a minimum of 5 feet below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
  4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall underpin the existing foundation, per Section 3.3 provide a concrete fill support under disturbed foundations, as directed by COR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by COR.
- B. Excavation Drainage: Operate pumping equipment , and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from COR. Approval by the COR is also required before placement of the permanent work on all subgrades.
- C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with concrete or material approved by the COR.
- D. Proofrolling:
1. After rough grade has been established in cut areas and prior to placement of fill in fill areas under building and pavements, proofroll exposed subgrade with a fully loaded dump truck to check for pockets of soft material.

2. Proofrolling shall consist of at least two complete passes with one pass being in a direction perpendicular to preceding one. Remove any areas that deflect, rut, or pump excessively during proofrolling, or that fail to consolidate after successive passes to suitable soils and replaced with compacted fill. Maintain subgrade until succeeding operation has been accomplished.

E. Building Earthwork:

1. Excavation shall be accomplished as required by drawings and specifications.
2. Excavate foundation excavations to solid undisturbed subgrade.
3. Remove loose or soft materials to a solid bottom.
4. Fill excess cut under footings or foundations with 3000 psi concrete poured separately from the footings.
5. Do not tamp earth for backfilling in footing bottoms, except as specified.
6. Slope grades to direct water away from excavations and to prevent ponding.

F. Trench Earthwork:

1. Utility trenches (except sanitary and storm sewer):
  - a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
  - b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
  - c. Support piping on undisturbed earth unless a mechanical support is shown.
  - d. Length of open trench in advance of piping laying shall not be greater than is authorized by COR.
2. Sanitary and storm sewer trenches:
  - a. Trench width below a point 6 inches above top of pipe shall be 24 inches maximum for pipe up to and including 12 inches diameter, and four-thirds diameter of pipe plus 8 inches for pipe larger than 12 inches. Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
  - b. Bed bottom quadrant of pipe on undisturbed soil or granular fill.
    - 1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 12 inches) above top of pipe shall be clean earth placed and tamped by hand.
    - 2) Granular Fill: Depth of fill shall be a minimum of 3 inches plus one sixth of pipe diameter below pipe to 12 inches above top of pipe. Place and tamp fill material by hand.

- c. Place and compact as specified remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
- d. Use granular fill for bedding where rock or rocky materials are excavated.

G. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements, and for inspections. Remove subgrade materials that are determined by COR as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the contractor shall obtain samples of the material, under the direction of the COR, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. Testing of the soil shall be performed by the VA Testing Laboratory. When unsuitable material is encountered and removed, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on volume in cut section only.

1. Site Grading:

- a. Provide a smooth transition between adjacent existing grades and new grades.
- b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:
  - 1) Lawn or Unpaved Areas: Plus or minus 1 inch.
  - 2) Walks: Plus or minus 1 inch.
  - 3) Pavements: Plus or minus 1 inch.
- d. Grading Inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10 foot straightedge.



### 3.3 FILLING AND BACKFILLING:

- A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Borrow will be supplied at no additional cost to the Government. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, foundation drainage, and pipes coming in contact with backfill have been installed and work inspected and approved by COR.
- B. Placing: Place materials in horizontal layers not exceeding 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.
- C. Compaction: Compact with approved tamping rollers, sheepsfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 10 feet of new or existing building walls without prior approval of COR. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 or ASTM D1557 as specified below:
  - 1. Fills, Embankments, and Backfill
    - a. Under proposed structures, building slabs, steps, and paved areas, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material in accordance with AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 95 percent.
    - b. Curbs, curbs and gutters, AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 95 percent.
    - c. Under Sidewalks, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material in accordance with AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 95 percent.

- d. Landscaped areas, top 16 inches, AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 85 percent.
- e. Landscaped areas, below 16 inches of finished grade, AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 90 percent.
- 2. Natural Ground (Cut or Existing)
  - a. Under building slabs, steps and paved areas, top 6 inches, AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 95 percent.
  - b. Curbs, curbs and gutters, top 6 inches, AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 95 percent.
  - c. Under sidewalks, top 6 inches, AASHTO T99 T180 Method A T 191 T 310 ASTM D698 D1557 Method A D 1556 D 2167 D 2922 95 percent.

### 3.4 GRADING:

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside building away from building walls for a minimum distance of 6 feet.
- D. Finish grade earth floors in pipe basements as shown to a level, uniform slope and leave clean.
- E. Finished grade shall be at least 6 inches below bottom line of window or other building wall openings unless greater depth is shown.
- F. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 6 inches unless otherwise shown.
- G. Finish subgrade in a condition acceptable to COR at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.

- H. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 0.25 inches of indicated grades.

**3.5 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. Disposal: Transport surplus satisfactory soil to designated storage areas on Medical Center property. Stockpile or spread soil as directed by COR.
  - 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.
- C. Place excess excavated materials suitable for fill and/or backfill on site where directed.
- D. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- E. Segregate all excavated contaminated soil designated by the COR from all other excavated soils, and stockpile on site on two 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.

**3.6 CLEAN UP:**

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from Medical Center.

----- E N D -----

**SECTION 31 20 01**  
**CONTAMINATED SOIL ABATEMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK:**

- A. This section specifies the requirements for storing, abatement and disposal of contaminated soil from excavation.

**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 3 inches; organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D 698 D 1557 AASHTO T 99 T 180.
- B. Contaminated soils: Soil that contains contaminants as defined and determined by the COR or the Government's testing agency.

**1.3 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.
- D. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- E. Site preparation: Section 31 23 19, DEWATERING, and Section 02 41 00, DEMOLITION. F. Paving sub-grade requirements: Section 32 12 16, ASPHALT PAVING.

**PART 2 - PRODUCTS**

**NOT INCLUDED**

**PART 3 - EXECUTION**

All soil delineated on plan sheet C-2 as contaminated soil and all suspect contaminated soil shall be segregated from non-contaminated soil and stockpiled on 10-mil polyethylene plastic sheeting and covered with the same.

- A. Collection and laboratory analyses of all waste characterization samples shall be performed by the Contractor. Contractor shall be

responsible for the proper disposal and permitting of all contaminated soil excavated for the project.

1. The Contractor shall notify the Owner a minimum for 5 working days prior to transporting waste materials from the site.
  2. Characterization of all waste materials shall be in accordance with USEPA waste characterization procedures and the specific requirements of the selected disposal facility.
- B. No wastes generated during the remedial activities shall be removed from the site until all necessary waste characterization sampling and analyses have been completed.
1. The Contractor shall dispose of soils which are unsuitable for reuse.
- E. The Contractor shall coordinate and pay for all necessary sampling and analyses of wastewater generated during the entire Contract to properly characterize it and ensure appropriate handling, transportation and disposal methods. Such wastewater includes, but is not limited to, water generated during excavation dewatering and decontamination operations.

----- E N D -----

**SECTION 31 23 19**  
**DEWATERING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

**1.2 SUMMARY:**

- A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
  - 1. Implementation of the Erosion and Sedimentation Control Plan.
  - 2. Dewater excavations, including seepage and precipitation.
- B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

**1.3 REQUIREMENT:**

- A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 1 foot below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.
- B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 1 foot below prevailing excavation surface.
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain stability of sides and bottom of excavation.
- E. Construction operations are performed in the dry.
- F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:
  - 1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase

and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.

2. Erosion is controlled.
3. Flooding of excavations or damage to structures does not occur.
4. Surface water drains away from excavations.
5. Excavations are protected from becoming wet from surface water, or insure excavations are dry before additional work is undertaken.

G. Permitting Requirements: The contractor shall comply with and obtain the required State and County permits where the work is performed.

**1.4 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
- E. Excavation, backfilling, site grade and utilities: Section 31 20 00, EARTH MOVING.

**1.5 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Drawings and Design Data:
  1. Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation.
  2. Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.
  3. Include a written report outlining control procedures to be adopted if dewatering problem arises.
  4. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.
- C. Inspection Reports.
- D. All required permits.

**PART 2 - EXECUTION**

**2.1 INSTALLATION:**

- A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.
- B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of 1 foot below prevailing excavation surface at all times.

**2.2 OPERATION:**

- A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.
- B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

**2.3 WATER DISPOSAL:**

- A. Dispose of water removed from the excavations in such a manner as:
  - 1. Will not endanger portions of work under construction or completed.
  - 2. Will cause no inconvenience to Government or to others working near site.
  - 3. Will comply with the stipulations of required permits for disposal of water.
  - 4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.
- B. Excavation Dewatering:
  - 1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.



2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
  3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
  4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.
- C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

**2.4 STANDBY EQUIPMENT:**

Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain dewatering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

**2.5 CORRECTIVE ACTION:**

If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor, at no additional cost to Government.

**2.6 DAMAGES:**

Immediately repair damages to adjacent facilities caused by dewatering operations.

**2.7 REMOVAL:**

Insure compliance with all conditions of regulating permits and provide such information to the Contracting Officer's Representative (COR). Obtain written approval from COR before discontinuing operation of dewatering system.

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**SECTION 32 05 23  
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown. Construction shall include the following:
- B. Curb, gutter, and combination curb and gutter wheel stop.
- C. Pedestrian Pavement: Walks, grade slabs, lawn mower strips, crossings, wheelchair curb ramps, terraces, and steps.
- D. Vehicular Pavement: Service courts, driveways.
- E. Equipment Pads: Transformers.

**1.2 RELATED WORK**

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Section 31 20 00, EARTH MOVING.
- C. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 53, CAST-IN-PLACE-CONCRETE.
- D. Metal Components of Steps (Nosing and Railing): Section 05 50 00, METAL FABRICATIONS.

**1.3 DESIGN REQUIREMENTS**

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

**1.4 WEATHER LIMITATIONS**

Placement of concrete shall be as specified under Article 3.4, PLACING CONCRETE of Section 03 30 53, CAST-IN-PLACE CONCRETE.

**1.6 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
  - 1. Expansion joint filler
  - 2. Hot poured sealing compound
  - 3. Reinforcement
  - 4. Curing materials

**1.7 APPLICABLE PUBLICATIONS**

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

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basic designation only. Refer to the latest edition of all referenced Standards and codes.

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

M031MM031-07-UL.....Deformed and Plain Carbon-Steel Bars for  
Concrete Reinforcement (ASTM A615/A615M-09)

M055MM055-09-UL.....Steel Welded Wire Reinforcement, Plain, for  
Concrete (ASTM A185)

M147-65-UL.....Materials for Aggregate and Soil-Aggregate  
Subbase, Base and Surface Courses (R 2004)

M148-05-UL.....Liquid Membrane-Forming Compounds for Curing  
Concrete (ASTM C309)

M171-05-UL.....Sheet Materials for Curing Concrete (ASTM C171)

M182-05-UL.....Burlap Cloth Made from Jute or Kenaf and Cotton  
Mats

M213-01-UL.....Preformed Expansion Joint Fillers for Concrete  
Paving and Structural Construction  
(Non-extruding and Resilient Bituminous Type)  
(ASTM D1751)

M233-86-UL.....Boiled Linseed Oil Mixer for Treatment of  
Portland Cement Concrete

T099-09-UL.....Moisture-Density Relations of Soils Using a 5.5  
lb Rammer and a 12 in. Drop

T180-09-UL.....Moisture-Density Relations of Soils Using a 10  
lb. Rammer and a 18 in. Drop

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

C94/C94M-09.....Ready-Mixed Concrete

C143/C143M-09.....Slump of Hydraulic Cement Concrete

## PART 2 - PRODUCTS

### 2.1 GENERAL

Concrete shall be Type C, air-entrained as specified in Section 03 30 53, CAST-IN-PLACE CONCRETE, with the following exceptions:

TYPE	MAXIMUM SLUMP*
Curb & Gutter	3"
Pedestrian Pavement	3"
Vehicular Pavement	2" (Machine Finished) 4" (Hand Finished)
Equipment Pad	3" to 4"

\* For concrete to be vibrated: Slump as determined by ASTM C143.  
Tolerances as established by ASTM C94.

## **2.2 REINFORCEMENT**

- A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.
- B. Welded wire-fabric shall conform to AASHTO M55.
- C. Dowels and tie bars shall be deformed steel bars conforming to AASHTO M31.

## **2.4 FORMS**

- A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.
- B. Do not use forms if they vary from a straight line more than 1/8 inch in any ten foot long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 2 inches thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects.  
Use approved flexible or curved forms for forming radii.

## **2.5 CONCRETE CURING MATERIALS**

- A. Concrete curing materials shall conform to one of the following:
  - 1. Burlap conforming to AASHTO M182 having a weight of seven ounces or more per square yard when dry.
  - 2. Impervious Sheeting conforming to AASHTO M171.
  - 3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), Type 1 and shall be free of paraffin or petroleum.

## **2.6 EXPANSION JOINT FILLERS**

Material shall conform to AASHTO M213.

## **PART 3 - EXECUTION**

### **3.1 SUBGRADE PENETRATION**

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTH MOVING.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

### **3.3 SETTING FORMS**

- A. Base Support:
  - 1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.

2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.

B. Form Setting:

1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
3. Forms shall conform to line and grade with an allowable tolerance of 1/8 inch when checked with a straightedge and shall not deviate from true line by more than 1/4 inch at any point.
4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
5. Clean and oil forms each time they are used.

C. The Contractor's Registered Professional Land Surveyor shall establish and control the alignment and the grade elevations of the forms or concrete slipforming machine operations.

1. Make necessary corrections to forms immediately before placing concrete.
2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

**3.4 EQUIPMENT**

- A. The COR shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

**3.5 PLACING REINFORCEMENT**

- A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement.
- B. Before the concrete is placed, the COR shall approve the reinforcement, which shall be accurately and securely fastened in place with suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown.

**3.6 PLACING CONCRETE - GENERAL**

- A. Obtain approval of the COR before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the COR before placing concrete.

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- C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.
- E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.
- F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.
- G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

### **3.7 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS**

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

### **3.8 PLACING CONCRETE FOR VEHICULAR PAVEMENT**

- A. Deposit concrete into the forms as close as possible to its final position.
- B. Place concrete rapidly and continuously between construction joints.
- C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.
- D. Finish the surface to the elevation and crown as shown.
- E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes without approval by the COR.

### **3.9 CONCRETE FINISHING - GENERAL**

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
  - 1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
  - 2. Maintain finishing equipment and tools in a clean and approved condition.

### **3.10 CONCRETE FINISHING CURB AND GUTTER**

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

### **3.11 CONCRETE FINISHING PEDESTRIAN PAVEMENT**

- A. Walks, Grade Slabs, Lawn Mower Crossings, Wheelchair Curb Ramps, Terraces:
  - 1. Finish the surfaces to grade and cross section with a metal float, trowled smooth and finished with a broom moistened with clear water.
  - 2. Brooming shall be transverse to the line of traffic.
  - 3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
  - 4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 1/16 inch in depth.

5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 3/16 inch when tested with a 10 foot straightedge.
6. The thickness of the pavement shall not vary more than 1/4 inch.
7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

### **3.12 CONCRETE FINISHING FOR VEHICULAR PAVEMENT**

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



### **3.13 CONCRETE FINISHING EQUIPMENT PADS**

- A. After the surface has been struck off and screeded to the proper elevation, give it a smooth dense float finish, free from depressions or irregularities.
- B. Carefully finish all slab edges with an edger having a radius as shown in the Drawings.
- C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary more than 1/8 inch when tested with a 10 foot straightedge.
- D. Correct irregularities exceeding the above.

### **3.14 JOINTS - GENERAL**

- A. Place joints, where shown, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.
- B. Joints shall be straight and continuous from edge to edge of the pavement.

### **3.15 CONTRACTION JOINTS**

- A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown or by sawing with a blade producing the required width and depth.
- B. Construct joints in curbs and gutters by inserting 1/8 inch steel plates conforming to the cross sections of the curb and gutter.
- C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.
- D. Finish edges of all joints with an edging tool having the radius as shown.
- E. Score pedestrian pavement with a standard grooving tool or jointer.

### **3.16 EXPANSION JOINTS**

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
  - 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
  - 2. Using joint filler of the type, thickness, and width as shown.

3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

### **3.17 CONSTRUCTION JOINTS**

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

### **3.18 FORM REMOVAL**

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

### **3.20 CURING OF CONCRETE**

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

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1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 200 square feet per gallon for both coats.
2. Do not allow the concrete to dry before the application of the membrane.
3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

**3.21 CLEANING**

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

**3.22 PROTECTION**

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the COR, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the COR.

**3.23 FINAL CLEAN-UP**

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

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

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

**1.2 RELATED WORK**

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 00, EARTH MOVING.

**1.3 INSPECTION OF PLANT AND EQUIPMENT**

The Contracting Officer's Representative (COR) shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

**1.4 ALIGNMENT AND GRADE CONTROL**

The Contractor's Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

**1.5 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Data and Test Reports:
  - 1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
  - 2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.
  - 3. Job-mix formula.
- C. Certifications:

1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
2. Asphalt cement certificate of conformance to State Highway Department requirements.
3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification.
- D. One copy of State Highway Department Specifications.
- E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

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

### **2.2 AGGREGATES**

- A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.
- B. Subbase aggregate (where required) maximum size: 1-1/2".
- C. Base aggregate maximum size:
  1. Base course over 6" thick: 1-1/2";
  2. Other base courses: 3/4".
- D. Asphaltic base course:
  1. Maximum particle size not to exceed 1".
  2. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.
- E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

<u>Sieve Sizes</u>	<u>Percentage Passing</u>
3/4"	100
3/8"	67 to 85
1/4"	50 to 65
No. 8 mesh	37 to 50
No. 30 mesh	15 to 25

No. 200 mesh

3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

### **2.3 ASPHALTS**

A. Comply with provisions of Asphalt Institute Specification SS2:

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

### **2.4 SEALER**

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

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

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

### **3.2 MIXING ASPHALTIC CONCRETE MATERIALS**

- A. Provide hot plant-mixed asphaltic concrete paving materials.
1. Temperature leaving the plant: 290 degrees F minimum, 320 degrees F maximum.
  2. Temperature at time of placing: 280 degrees F minimum.

### **3.3 SUBGRADE**

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 50 ton gross weight dump truck as directed by VA COR. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

### **3.4 BASE COURSES**

- A. Subbase (when required)
  - 1. Spread and compact to the thickness shown on the drawings.
  - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
  - 3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.
- B. Base
  - 1. Spread and compact to the thickness shown on the drawings.
  - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
  - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0" to plus 0.5"
- D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 3/16 inch in ten feet.
- E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

### **3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING**

- A. Remove all loose materials from the compacted base.
- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Engineer.
- C. Receipt of asphaltic concrete materials:
  - 1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 280 degrees F.
  - 2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 50 degrees F, not during fog, rain, or other unsuitable conditions.
- D. Spreading:
  - 1. Spread material in a manner that requires the least handling.
  - 2. Where thickness of finished paving will be 3" or less, spread in one layer.
- E. Rolling:
  - 1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.

2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
  - a. No depressions which will retain standing water.
  - b. No deviation greater than 1/8" in six feet.

### **3.6 APPLICATION OF SEAL COAT**

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

### **3.7 PROTECTION**

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

### **3.8 FINAL CLEAN-UP**

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

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**SECTION 32 31 13**  
**CHAIN LINK FENCES AND GATES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This work consists of all labor, materials, and equipment necessary for furnishing and installing chain link fence, gates and accessories in conformance with the lines, grades, and details as shown.

**1.2 RELATED WORK**

- A. Grounding of fencing for enclosures of electrical equipment and for lightning protection as shown: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- B. Temporary Construction Fence: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Finish Grading: Section 31 20 00, EARTH MOVING.

**1.3 MANUFACTURER'S QUALIFICATIONS**

Fence, gates, and accessories shall be products of manufacturers' regularly engaged in manufacturing items of type specified.

**1.4 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES, furnish the following:
  - 1. Manufacturer's Literature and Data: Chain link fencing, gates and all accessories indicating material compliance and specified options.
  - 2. Manufacturer's Certificates: Zinc-coating complies with specifications.
- B. Shop Drawings for layout of fences and gates with dimensions, details, and finishes of components, accessories, and post foundations.

**1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - A121-07.....Metallic Coated Carbon Steel Barbed Wire
  - A392-07.....Zinc-Coated Steel Chain-Link Fence Fabric
  - A817-07.....Metal-Coated Steel Wire for Chain-Link Fence  
Fabric and Marcellled Tension Wire
  - C94/C94M-07.....Ready-Mixed Concrete



accessories conforming to ASTM F626. Provide one cap for each post. "C" shaped line post without top rail do not require post caps. When top rail is specified provide line post loop tops to secure top rail.

## **2.9 GATES**

ASTM F900, type as shown. Gate framing, bracing, latches, and other hardware zinc-coating weight shall be the same as the FABRIC. The gate frame members are to be spaced no greater than 8' 0" apart horizontally or vertically with truss rods or intermediate braces. Attach gate fabric to the gate frame by method standard with the manufacturer, except that welding will not be permitted. Arrange latches for padlocking so that padlock will be accessible from both sides of the gate regardless of the latching arrangement. When required, extend each end member of gate frame sufficiently above the top member or provide three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

## **2.10 GATE HARDWARE**

- A. Manufacturer's standard products, installed complete. The type of hinges shall allow gates to swing through 180 degrees, from closed to open position. Hang and secure gates in such a manner that, when locked, they cannot be lifted off hinges.
- B. Equip gate openings with padlock conforming to Fed Spec FF-P-110H, Type EPC, size 50 mm (2 inch). Padlocks shall have chains that are securely attached to the gate or gate post. Before padlocks are delivered to project, submit sample to COR for approval. Approved sample may be incorporated in work. Key padlock as directed by the COR.

## **2.11 CONCRETE**

ASTM C94/C94M, using 19 mm (3/4 inch) maximum-size aggregate, and having minimum compressive strength of 25 mPa (3000 psi) at 28 days. Non-shrinking grout shall consist of one part Portland cement to three parts clean, well-graded sand, non-shrinking grout additive and the minimum amount of water to produce a workable mix.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Install fence by properly trained crew, on previously prepared surfaces, to line and grade as shown. Install fence in accordance with ASTM F567 and with the manufacturer's printed installation instructions, except as modified herein or as shown. Maintain all equipment, tools, and machinery while on the project in sufficient

quantities and capacities for proper installation of posts, chain links and accessories.

### **3.2 EXCAVATION**

Excavation for concrete-embedded items shall be of the dimensions shown, except in bedrock. If bedrock is encountered before reaching the required depth, continue the excavation to the depth shown or 450 mm (18 inches) into the bedrock, whichever is less, and provide a minimum of 50 mm (2 inches) larger diameter than the outside diameter of the post. Clear loose material from post holes. Grade area around finished concrete footings as shown and dispose of excess earth as directed by the COR.

### **3.3 POST SETTING**

Install posts plumb and in alignment. Set post in concrete footings of dimensions as shown, except in bedrock. Thoroughly compact concrete so as it to be free of voids and finished in a slope or dome to divert water running down the post away from the footing. Straight runs between braced posts shall not exceed 150 m (500 feet). Install posts in bedrock with a minimum of 25 mm (one inch) of non-shrinking grout around each post. Thoroughly work non-shrinking grout into the hole so as to be free of voids and finished in a slope or dome. Cure concrete and grout a minimum of 72 hours before any further work is done on the posts.

### **3.5 POST CAPS**

Fit all exposed ends of post with caps. Provide caps that fit snugly and are weathertight. Where top rail is used, provide caps to accommodate the top rail. Install post caps as recommended by the manufacturer and as shown.

### **3.6 SUPPORTING ARMS**

Design supporting arms, when required, to be weathertight. Where top rail is used, provide arms to accommodate the top rail. Install supporting arms as recommended by the manufacturer and as shown.

### **3.7 TOP RAILS AND BOTTOM RAILS**

Install rails before installing chain link fabric. Provide suitable means for securing rail ends to terminal and intermediate post. Top rails shall pass through intermediate post supporting arms or caps as shown. The rails shall have expansion couplings (rail sleeves) spaced as recommended by the manufacturer. Where fence is located on top of a wall, install expansion couplings over expansion joints in wall.

### **3.8 TOP AND BOTTOM TENSION WIRE**

Install and pull taut tension wire before installing the chain-link fabric.

### **3.9 ACCESSORIES**

Supply accessories (posts braces, tension bands, tension bars, truss rods, and miscellaneous accessories), as required and recommended by the manufacturer, to accommodate the installation of a complete fence, with fabric that is taut and attached properly to posts, rails, and tension wire.

### **3.10 FABRIC**

Pull fabric taut and secured with wire ties or clips to the top rail bottom rail and tension wire close to both sides of each post and at intervals of not more than 600 mm (24 inches) on centers. Secure fabric to posts using stretcher bars and ties or clips.

### **3.11 BARBED WIRE**

Install barbed wire, when required, on supporting arms above the fence posts. Extend each end member of gate frames sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence. Pull each strand taut and securely fasten to each supporting arm and extended member.

### **3.12 GATES**

Install gates plumb, level, and secure for full opening without interference. Set keepers, stops and other accessories into concrete as required by the manufacturer and as shown. Adjust hardware for smooth operation and lubricate where necessary.

### **3.13 REPAIR OF GALVANIZED SURFACES**

Use galvanized repair compound, stick form, or other method, where galvanized surfaces need field or shop repair. Repair surfaces in accordance with the manufacturer's printed directions.

### **3.14 FINAL CLEAN-UP**

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

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**SECTION 33 10 00**  
**WATER UTILITIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

Underground water distribution system complete, ready for operation, including all appurtenant structures, and connections to both new building service lines and to existing water supply.

**1.2 RELATED WORK:**

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing: Section 31 20 00, EARTH MOVING.
- C. Concrete: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- D. Protection of materials and equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**1.3 DEFINITIONS:**

- A. Water Distribution: Pipelines and appurtenances which are part of the distribution system. The distribution system comprises the network of piping located throughout building areas and other areas of water use, including hydrants, valves, and other appurtenances used to supply water for domestic and fire-fighting/fire protection purposes.
- B. Water Service Line: Pipe line connecting building piping to water distribution lines.

**1.4 QUALITY ASSURANCE:**

- A. Products Criteria:
  - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be product of one manufacturer.
  - 2. Nameplate: Nameplate bearing manufacturer's name or identifiable trademark securely affixed in a conspicuous place on equipment or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Water lines and the extension, and/or modifications to Public Utility systems.
- C. Comply with all rules and regulations of Federal, State, and Local Health Department and Department of Environmental Quality having jurisdiction over the design, construction, and operation of potable water systems.

- D. All material surfaces in contact with potable water shall comply with NSF 61.

**1.5 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data (Submit all items as one package):  
(Ductile Iron Pipe and Polyvinyl Chloride (PVC) shall be in accordance with AWWA C600 and C605 respectively; and shall be provided to Contracting Officer's Representative (COR) for approval.)
1. Piping.
  2. Gaskets.
  3. Valves.
  4. Fire hydrants.
  5. Street washer.
  6. Meter.
  7. Vaults, frames and covers.
  8. Steps.
  9. Post indicator.
  10. Valve boxes.
  11. Corporation and curb stops.
  12. Curb stop boxes.
  13. Joint restraint.
  14. Disinfection products.
  15. Link/sleeve seals.
- C. Testing Certifications:
1. Certification of Backflow Devices.
  2. Hydrostatic Testing.
  3. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.

**1.6 APPLICABLE PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI/ASME):
- B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings
- B16.18.....Cast Bronze Solder Joint Pressure Fittings
- B16.26-88.....Cast Copper Alloy Fittings for Flared Copper  
Tubes
- B40.100-98.....Pressure Gauges and Gauge Attachments

693-09-128

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

A123-97.....	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A148M-03.....	Standard Specifications for Steel Castings
A242-00.....	Standard Specifications for High Strength Low Alloy Structural Steel AASHTO No. M161
A307-02.....	Standard Specifications for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A536-04.....	Standard Specifications for Ductile Iron Castings
B61-02.....	Steam or Valve Bronze Castings
B62-02.....	Composition Bronze or Ounce Metal Castings
B88-02.....	Seamless Copper Water Tube
B828.....	Standard Practice: Soldering and Brazing Copper Tube and fittings
C32-04.....	Sewer and Manhole Brick (Made from Clay or Shale)
C139-03.....	Concrete Masonry Units for Construction of Catch Basins and Manholes
D1784-03.....	Standard Specifications for Rigid PVC Compounds and CPVC Compounds
D1869-00.....	Standard Specifications for Rubber Rings for Asbestos Cement Pipe
D2464-99.....	Standard Specifications for Threaded PVC Pipe Fittings, Schedule 80
D2467-02.....	Standard Specifications for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
D3139-98.....	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
F477-02e1.....	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
C32-04.....	Standard Specifications for Sewer Manhole Brick

## D. American Water Works Association (AWWA):

B300-04.....	Hypochlorites
B301-04.....	Liquid Chlorine
C104-04.....	Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
C105-99.....	Polyethylene Encasement for Gray and Ductile C.I. Piping for Water and Other Liquids



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- C110-03.....Ductile-Iron and Gray-Iron Fittings, 3 Inches  
Through 48 Inches for Water and Other Liquids
- C111-01.....Rubber-Gasket Joints for Ductile-Iron and  
Gray-Iron Pressure Pipe and Fittings
- C115-99.....Flanged Ductile-Iron and Gray-Iron Pipe with  
Threaded Flanges
- C150-02.....American National Standard for Thickness Design  
of Ductile Iron Pipe
- C151-96.....Ductile-Iron Pipe, Centrifugally Cast in Metal  
Molds or Sand-Lined Molds, for Water or Other  
Liquids
- C153-00.....Ductile-Iron Compact Fittings, 3 inches Through  
12 Inches for Water and Other Liquids
- C500-02.....Gate Valves for Water and Sewerage Systems
- C502a-95.....Dry-Barrel Fire Hydrants
- C503-97.....Wet-Barrel Fire Hydrants
- C508-01.....Swing Check Valves for Waterworks Service, 2  
Inches Through 24 Inches NPS
- C509-01.....Resilient Seated Gate Valve for Water and Sewage  
System
- C510-97.....Double Check Valve Back-Flow Prevention Assembly
- C511-97.....Reduced Pressure Principle Back-Flow Prevention  
Assembly
- C550-01.....Protective Epoxy Interior Coatings for Valves  
and Hydrants
- C600-01.....Installation for Ductile-Iron Water Mains and  
Their Appurtenances
- C605-94.....Underground Installation of Polyvinyl Chloride  
(PVC) Pressure Pipe and Fittings for Water
- C651-92.....Disinfecting Water Mains
- C800-01.....Underground Service Line Valves and Fittings
- C900-97.....Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches  
Thru 12 Inches, for Water
- C905-97.....Polyvinyl Chloride (PVC) Pressure Pipe 14 Inches  
Thru 36 Inches
- E. National Fire Protection Association (NFPA):
  - 24-95.....Installation of Private Fire Service Mains and  
Their Appurtenances
  - 291-01.....Fire Flow Testing and Marking of Hydrants
  - 1141-98.....Fire Protection in Planned Building Groups

F. NSF International:

- 14-03.....Plastics Piping Components and Related Materials
- 61-02.....Drinking Water System Components-Health Effects  
(Sections 1-9)

G. American Welding Society (AWS):

- A5.8-04.....Brazing Filler Metal

H. Foundation for Cross-Connection Control and Hydraulic Research-2005

I. Copper Development Association's Copper Tube Handbook-2005

**PART 2 - PRODUCTS**

**2.1 DUCTILE IRON PIPE AND FITTINGS:**

A. Ductile iron pipe, direct buried:

1. Provide ductile iron pipe conforming to the requirements of AWWA C151, Pressure Class 350 for Pipe 4 inches through 12 inches in diameter and 250 for pipe larger than 12 inches in diameter, with standard thickness cement mortar lining interior, and interior asphaltic seal coat and exterior asphaltic coating, in accordance with AWWA and ANSI Standards.
2. Below Grade: Supply pipe in lengths not in excess of a nominal 20 feet with rubber ring type mechanical joint with retainer gland or approved restrained joint. Provide flange joint pipe where shown on the drawings. Provide mechanical joint with ductile iron retainer gland and restrained joint pipe with sufficient quantities of accessories as required for each joint.
3. When a polyethylene encasement over pipe, fittings, and valves is a requirement as indicated on the drawings, the material, installation and workmanship shall conform to applicable sections of AWWA C105. Make provisions to keep the polyethylene from direct exposure to sunlight prior to installation. Backfill following installation without delay to avoid exposure to sunlight.

B. Ductile Iron Pipe Above Grade or in Below Ground Concrete Pits:

1. Flanged ductile iron pipe, AWWA C115, with factory applied screwed long hub flanges except as otherwise specified hereinafter. Face and drill flanges after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and flush with end of pipe, ANSI B16.1, 125 psi or 250 psi standard, for the purpose intended.
2. Wall Sleeve Castings: Size and types shown on the drawings and be hot dipped galvanized.
3. Pipe Thickness Class: Minimum of Class 53 as defined in AWWA C150 for all sizes of flanged pipe.

4. Rubber Ring Gaskets: Full face type, AWWA C111, 1/16 inch rubber ring gaskets and of approved composition suitable for the required service.
5. Pipe and fittings exposed to view in the finished work are to be painted. Pipe shall not receive the standard tar or asphalt coat on the outside surfaces but shall be shop primed on the outside with one coat of Rust Inhibitive Primer. Paint color shall match the wall color.
6. Bolts and Nuts on Flanged Fittings: Grade B, ASTM A307. Low alloy, high strength steel in accordance with AWWA C111. Assemble stainless steel bolts and nuts using anti-seize compound to prevent galling.
- C. All Pipe Fittings: Ductile iron with a minimum pressure rating of 350 psi. Fittings shall meet the requirements of ANSI and AWWA specifications as applicable. Rubber gasket joints shall conform to AWWA C111 for mechanical and push-on type joints. Ball joints shall conform to AWWA C151 with a separately cast ductile iron bell conforming to ASTM A148. Flanged fittings shall conform to AWWA C115 and be furnished flat faced and drilled to 125 psi or 250 psi template in accordance with ANSI B16.1 with full faced gaskets.
- D. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior.
- E. Provide a factory hydrostatic test of not less than 500 psi for all pipe in accordance with AWWA C151.
- F. Provide non-detectable adhesive backed identification tape on top and sides of all buried ductile iron pipe, extended from joint to joint along the length of the pipe and have black lettering identifying the pipe service at no more than 12 inch intervals. According to service, the tape background color shall be as follows: potable water-blue.

## **2.2 POLYVINYL CHLORIDE PIPE AND FITTINGS:**

- A. Class-Rated Polyvinyl Chloride (PVC) Pipe:
  1. PVC pipe and accessories 4 inches-14 inches in diameter, AWWA C900 "Polyvinyl Chloride (PVC) Pressure Pipe", Class 200, DR 14, cast iron outside diameters, unless otherwise shown or specified.
  2. PVC pipe and accessories 16 inches or larger, AWWA C905, "Polyvinyl Chloride Water Transmission Pipe", Class 235, DR 18, cast iron outside diameters unless otherwise shown or specified. Pipe and accessories shall bear the NSF mark indicating pipe size, manufacturer's name, AWWA and/or ASTM Specification number, working

pressure and production code. Pipe and couplings shall be made in accordance with ASTM D1784.

3. PVC Pipe and Accessories Smaller than 4 inches: Schedule 80, meeting the requirements of ASTM D-1785, Type 1, Grade 1. All exposed piping shall be CPVC meeting requirements of ASTM F441.

B. Joints:

1. Pipe 3 inches and Greater in Diameter: Push-on type with factory installed solid cross section elastomeric ring meeting the requirements of ASTM F-477.
2. Pipe Less Than 3 inches in Diameter: Threaded (ASTM D-2464) or solvent welded (ASTM 2467). Use Teflon tape or liquid Teflon thread lubricant approved for use on plastic on all threaded joints.

C. Fittings:

1. Class-Rated Pipe 3 inches in Diameter and Greater: Ductile iron with mechanical joints conforming to the requirements of AWWA C153.
2. For Schedule 80 Pipe less than 3 inches in Diameter: Threaded or solvent weld. Threaded PVC fittings shall conform to ASTM D2464. CPVC fittings shall conform to ASTM F437 for threaded fittings and ASTM F439 for solvent weld fittings.

**2.3 COPPER PIPE AND TUBING:**

Copper Piping: ASTM B88, Type K, or Type L with flared fittings in accordance with AWWA C800, with sweat cast brass fittings per ANSI B16.18. Use brazing alloy, AWS A5.8, Classification BCuP.

**2.4 VALVES:**

A. Asbestos packing is not allowed.

B. Gate:

1. 3 inches and Larger: Resilient seated, ductile iron body, bronze mounted, inclined seats, non-rising stem type turning counter-clockwise to open, 200 pound WOG. AWWA C509. The resilient seat shall be fastened to the gate with stainless steel fasteners or vulcanizing methods. The interior and exterior shall be coated with thermo-setting or fusion epoxy coating in accordance with AWWA C550.
2. Operator:
  - a. Underground: Except for use with post indicators, furnish valves with 2 inch nut for socket wrench operation. Post indicator shall comply with the requirements of NFPA 24 and shall be fully compatible with the valve provided.
  - b. Above Ground and in Pits: Hand wheels.
3. Joints: Ends of valves shall accommodate, or be adapted to, pipe installed.

C. Check: Swing.

1. Smaller than 4 inches: Bronze body and bonnet, ASTM B61 or B62, 200 pound WOG.
2. 4 inches and Larger: Iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, 200 pound WOG. Check valves for fire lines shall conform to AWWA C508 and shall be epoxy coated and lined per AWWA C550.

D. Corporation stops and saddles shall conform to AWWA C800.

E. Curb Stop: Smaller than 3 inches. Waterworks standard for Type "K" copper, single piece cast bronze body with tee top operated plug sealed with O-ring gaskets, 200 pound WOG per AWWA C800.

**2.5 CURB STOP BOX:**

Cast iron extension box with screw or slide type adjustment and flared base. Box shall be adapted, without full extension, to depth of cover required over pipe at stop location. Cast the word "WATER" in cover and set cover flush with finished grade. Curb stop shut-off rod shall extend 2 feet above top of deepest stop box.

**2.6 VALVE BOX:**

Cast iron extension box with screw or slide-type adjustment and flared base. Minimum thickness of metal shall be 3/16 inch. Box shall be adapted, without full extension, to depth of cover required over pipe at valve location. Cast the word "WATER" in cover. Provide 4 T" handle socket wrenches of 5/8 inch round stock long enough to extend 2 feet above top of deepest valve box.

**2.7 POST INDICATOR VALVE:**

- A. Valve: Valve shall conform to the specifications listed in Section 2.4 for gate valves. The Post Indicator shall conform to NFPA 24, and shall be fully compatible with the valve and all the supervisory switches.

**2.8 FIRE HYDRANTS:**

- A. Size of main valve opening of each hydrant shall be 5 inches, minimum. Hose thread, size of fire apparatus connection, and shape, size and direction of rotation of operating head of hydrant shall be identical with present local fire department and/or water department standards those in use at station.
- B. Hydrant shall be type AWWA C502, heavy construction, of proper length to connect pipe without extra fittings, and shall be the traffic type with safety flange on barrel and safety couplings on the valve stem with the following features:
1. Interior removable without digging up hydrant; can be packed under pressure; 6 inch bell connection; one steamer nozzle and two hose

nozzles with nozzle caps securely chained to barrel; suitable drainage device; single rubber or leather-faced valve in base; nozzles, stuffing boxes, wedge nuts, seat rings, clamp plates, etc. Threaded joints or spindles shall be bronze. Upper and lower barrels shall be of equal diameters. Upper barrel shall be of sufficient length to permit setting hydrant with barrel flange not more than 2 inches above finished grade. All fire hydrants shall have 6 inch bottom connection.

2. Provide fire hydrants with a finish paint identical to the existing fire hydrants.

C. Provide two (2) wrenches with handles not less than 14 inches long.

## **2.9 PIPE SLEEVES:**

Ductile iron or zinc coated steel. Solid sleeves shall be installed with ductile iron retainer glands and shall be installed in accordance with manufacturers recommendations. Solid sleeves shall be installed where shown on the drawings and where necessary to prevent movement of cut out lengths of pipe that are to be rejoined.

## **2.10 BACKFLOW PREVENTER:**

- A. Potable Water and Irrigation Water Service: Reduced Pressure Principle Type AWWA C511, except pressure drop at rated flow shall not exceed 15 psi. Gate valves installed on the assembly shall be resilient seated valve conforming to AWWA C509.
- B. Fire Service: Double detector check valve. AWWA C510 and NFPA 14.
- C. In cold climate areas, backflow assemblies and devices shall be protected from freezing by a method acceptable to local jurisdiction.
- D. Backflow preventers shall be approved by the Foundation for Cross-Connection Control and Hydraulic Research per current edition of the Manual of Cross-Connection Control.
- E. Backflow preventer shall not be located in any area containing fumes that are toxic, poisonous or corrosive.
- F. Direct connections between potable water piping and sewer connected wastes shall not exist under any condition with or without backflow protection.
- G. Backflow preventer shall be accessed and have clearance for the required testing, maintenance and repair. Access and clearance shall require a minimum of one (1) foot between the lowest portion of the assembly and grade, floor or platform. Installations elevated more than five (5) feet above the floor or grade shall be provided with a permanent platform capable of supporting a tester or maintenance person.

**2.11 CAST IRON FRAME AND COVER, STEPS, ETC.:**

Cast iron frame and cover, steps, etc. shall comply with State Department of Transportation standard details. Identify cover as "WATER".

**2.12 FLEXIBLE EXPANSION JOINTS: (PROVIDE FOR DOMESTIC AND FIRE SERVICE)**

Ductile iron with ball joints rated for 250 PSI working pressure conforming to ANSI/AWWA A21.53/C153, capable of deflecting a minimum of 30 degrees and expanding simultaneously to the amount shown on the drawings. Flexible expansion joint shall have the expansion capability designed as an integral part of the ductile iron ball castings. Pressure containing parts shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213 and shall be factory holiday tested with a 1500 volt spark test. Flexible expansion joint shall have flanged connections conforming to ANSI/AWWA A21.11/C110. Bolts and nuts high strength steel with synthetic gaskets that comply with AWWA C110.

**2.13 POTABLE WATER:**

Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

**2.14 DISINFECTION CHLORINE:**

- A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.
- B. Sodium hypochlorite shall conform to AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5.g tablets, and shall contain 65 percent chlorine by weight.
- D. After the applicable retention period, heavily chlorinated water should not remain in contact with pipe for more than 48 hours. In order to prevent damage to the pipe lining or corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use.

Heavily chlorinated water (greater than 0.5 mg/l residual) must be dechlorinated and disposed of in a manner that conforms to all local, State and Federal regulations.

If the CONTRACTOR elects to direct the heavily chlorinated water to the sanitary sewer system, the CONTRACTOR shall contact the local sewer department to ascertain any requirements for discharge. Any fees associated with discharge to the sanitary sewer system shall be included in the unit prices bid under Item 1.

If the CONTRACTOR elects to direct the heavily chlorinated water to a storm sewer system, the chlorine residual of water being disposed shall be neutralized by treating with one of the reducing agents listed in Table 1. The amount of reducing agent applied shall be sufficient to

lower the chlorine residual of the water disposed to 0.0 mg/l. If the CONTRACTOR elects to utilize a chemical for dechlorination, the water shall be aerated prior to discharge to the storm sewer system.

**TABLE 1**

Pounds of chemicals required to neutralize various residual chlorine concentrations in 100,000 gallons of water.

Residual Chlorine Concentration mg/l	Sulfur Dioxide (SO <sub>2</sub> )	Sodium Bisulfite (NaHSO <sub>3</sub> )	Sodium Sulfite (NaSO <sub>3</sub> )	Sodium Thiosulfate Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> .5H <sub>2</sub> O
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

#### **2.15 WARNING TAPE**

Standard, 4-Mil polyethylene 3 inch wide tape, detectable type, blue with black letters, and imprinted with "CAUTION BURIED WATER LINE BELOW".

#### **2.16 HIGH DEFLECTION FITTINGS (DOUBLE SWIVEL JOINT PIPE AND FITTINGS)**

- A. High deflection fittings shall be provided as shown on the Contract Drawings.
- B. Fittings shall be ductile iron, double-swivel and shall be provided with all glands, rods, nuts and bolts required to install the fittings.
- C. A high deflection fitting capable of allowing a minimum of 12-inches of offset is to be provided.
- D. Fittings shall be suitable for working pressures to 350 psi.

### **PART 3 - EXECUTION**

#### **3.1 BUILDING SERVICE LINES:**

Install water service lines to point of connection within approximately 5 feet outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed provide temporary caps.

#### **3.2 REGRADING:**



Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.

**3.3 PIPE LAYING, GENERAL:**

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the COR.
- B. All pipe and fittings shall be subjected to a careful inspection just prior to being laid or installed. If any defective piping is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional expense to the Government. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when installed or laid, shall conform to the lines and grades required.
- C. All buried piping shall be installed to the lines and grades as shown on the drawings. All underground piping shall slope uniformly between joints where elevations are shown.
- D. Contractor shall exercise extreme care when installing piping to shore up and protect from damage all existing underground water line and power lines, and all existing structures.
- E. Do not lay pipe on unstable material, in wet trench, or when trench or weather conditions are unsuitable.
- F. Do not lay pipe in same trench with other pipes or utilities unless shown otherwise on drawings.
- G. Hold pipe securely in place while joint is being made.
- H. Do not walk on pipes in trenches until covered by layers of earth well tamped in place to a depth of 12 inches over pipe.
- I. Full length of each section of pipe shall rest solidly upon pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipes on wood blocking.
- J. Tees, plugs, caps, bends and hydrants on pipe installed underground shall be anchored. See section 3.7 "PIPE SUPPORTS".
- K. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water and chemical, or mechanical injury. At completion of all work, thoroughly clean exposed materials and equipment.
- L. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the manufacturer.

- M. Warning tape shall be continuously placed 12 inches above buried water pipes.

#### **3.4 DUCTILE IRON PIPE:**

- A. Installing Pipe: Lay pipe in accordance with AWWA C600 with polyethylene encasement if required in accordance with AWWA C105. Provide a firm even bearing throughout the length of the pipe by tamping selected material at the sides of the pipe up to the spring line.
- B. All pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Cement lining shall be undamaged.
- D. Jointing Ductile-Iron Pipe:
  - 1. Push-on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe is to be aligned with the bell of the pipe to which it is joined, and pushed home with approved means.
  - 2. Mechanical Joints at Valves, Fittings: Install in strict accordance with AWWA C111. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gaskets with soapy water before tightening the bolts. Bolts shall be tightened to the specified torque.
  - 3. Flanged joints shall be in accordance with AWWA C115. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

#### **3.5 PVC PIPE:**

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA 605. Place selected material and thoroughly compacted to one foot above the top of the pipe and thereafter back filled as specified in Section 31 20 00, EARTH MOVING.
- B. Copper Tracer Wire: Copper tracer wire consisting of No. 14 AWG solid, single conductor, insulated copper wire shall be installed in the trench with all piping to permit location of the pipe with electronic detectors. The wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be made by stripping the insulation from the wire and soldering with rosin core solder. Solder joints shall

be wrapped with rubber tape and electrical tape. At least every 1000 feet, provide a 5 pound magnesium anode attached to the main tracer wire by solder. The solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall be attached at the end of each line.

- C. Magnetic markers may be used in lieu of copper tracer wire to aid in future pipe locating. Generally, install markers on 20 foot centers. If pipe is in a congested piping area, install on 10 foot centers. Prepare as-built drawing indicating exact location of magnetic markers.

### **3.6 COPPER PIPE:**

Copper piping shall be installed in accordance with the Copper Development Association's Copper Tube Handbook and manufacturer's recommendations. Copper piping shall be bedded in 6 inches of sand and then back filled as specified in Section 31 20 00, EARTH MOVING.

### **3.7 PIPE SUPPORTS:**

#### **A. Supports:**

1. All piping shall be properly and adequately supported. Hangers, supports, base elbows and tees, and concrete piers and pads shall be provided as indicated on the drawings. If the method of support is not indicated on the drawings, exposed piping shall be supported by hangers wherever the structure is suitable and adequate to carry the superimposed load. Supports shall be placed approximately 8 feet on centers and at each fitting.
2. Hangers shall be heavy malleable iron of the adjustable swivel type, split ring type, or the adjustable-swivel, pipe-roll type for horizontal piping and adjustable, wrought iron, clamp type for vertical piping. Flat steel strap or chain hangers are not acceptable unless indicated on the drawings.
3. Hangers shall be attached to the structure, where possible, by beam clamps and approved concrete inserts set in the forms before concrete is poured. Where this method is impractical, anchor bolts with expanding lead shields, rawl drives, or malleable iron expansion shields will be permitted.
4. Where hangers cannot be used, the Contractor shall provide pipe saddle supports with pipe column and floor flange.

### **3.8 RESTRAINED JOINTS:**

- A. Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained "locked-type" joints and the joints shall be capable of holding against withdrawal for line pressures 50 percent above the normal working pressure but not less than 200 psi.

The pipe and fittings shall be restrained push-on joints or restrained mechanical joints.

- B. The minimum number of restrained joints required for resisting force at fittings and changes in direction of pipe shall be determined from the length of retained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. Restrained pipe length shall be as shown on the drawings.
- E. Ductile iron pipe bell and spigot joints and mechanical joint fittings shall be restrained. The restraining device shall be designed to fit standard mechanical joint bells with standard T head bolts conforming to AWWA C111 and AWWA C153. Glands shall be manufactured of ductile iron conforming to ASTM A536. Set screws shall be hardened ductile iron and require the same torque in all sizes. Steel set screws not permitted. These devices shall have the stated pressure rating with a minimum safety factor of 2:1. Glands shall be listed with Underwriters Laboratories and/or approved by Factory Mutual.
- F. All fittings shall be securely anchored by suitable blocking and/or by an approved bolted metal harness and/or approved restrained joints. Refer to plans for specific anchorage requirements.
- G. Reaction or thrust blocking shall be Class C (2500 lbs.) concrete. Blocking shall be placed between solid ground and the fittings with adequate bearing area on the pipe and the ground. Blocking, clamps, and methods of anchorage shall be such as to permit accessibility for joint repair. Metal harnesses of tie rods and metal clamps of adequate strength to prevent movement or other approved means may be used where concrete blocks cannot be used. Rods and clamps shall be painted with a corrosion resistant asphaltum. Reaction or thrust blocking metal harnesses of tie rods and clamps shall not be used without written authorization from the Engineer.
- H. Where fittings are anchored by the use of restrained joints, the type of joint must be as specified or approved by the Engineer and a sufficient number of straight pipe lengths both sides of the fittings must be furnished with restrained joints designed to withstand the thrust due to the internal test pressure. Deflection of the joints shall be in accordance with the manufacturer's recommendations. All mechanical joint fittings shall be supplied with ductile iron retainer glands unless otherwise directed by the Engineer.

- J. Where ductile iron pipe manufactured with restrained joints is utilized, all restrained joints shall be fully extended and engaged prior to back filling the trench and pressurizing the pipe.
- K. PVC pipe bell and spigot joints shall be restrained. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.
- L. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A-536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.

### **3.9 PIPE SEPARATION:**

- A. Horizontal Separation-Water Mains and Sewers:
  - 1. Water mains shall be located at least 10 feet horizontally from any proposed drain, storm sewer, sanitary or sewer service connection.
  - 2. Water mains may be located closer than 10 feet to a sewer line when:
    - a. Local conditions prevent a lateral separation of 10 feet; and
    - b. The water main invert is at least 18 inches above the crown of the sewer; and
    - c. The water main is either in a separate trench or in the same trench on an undisturbed earth shelf located one side of the sewer.
  - 3. When it is impossible to meet (1) or (2) above, both the water main and drain or sewer shall be constructed of mechanical joint ductile iron pipe. Ductile iron pipe shall comply with the requirements listed in this specification section. The drain or sewer shall be pressure tested to the maximum expected surcharge head before back filling.
- B. Vertical Separation-Water Mains and Sewers:
  - 1. A water main shall be separated from a sewer so that its invert is a minimum of 18 inches above the crown of the drain or sewer whenever water mains cross storm sewers, sanitary sewers or sewer service connections. The vertical separation shall be maintained for that portion of the water main located within 10 feet horizontally of any sewer or drain crossed. A length of water main pipe shall be centered over the sewer to be crossed with joints equidistant from the sewer or drain.

2. Both the water main and sewer shall be constructed of slip-on or mechanical joint ductile iron pipe or PVC pipe equivalent to water main standards of construction when:
  - a. It is impossible to obtain the proper vertical separations described in (1) above; or
  - b. The water main passes under a sewer or drain.
3. A vertical separation of 18 inches between the invert of the sewer or drain and the crown of the water main shall be maintained where a water main crosses under a sewer. Support the sewer or drain lines to prevent settling and breaking the water main.
4. Construction shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer or drain line is at least 10 feet.

**3.10 SETTING OF VALVES AND BOXES:**

- A. Provide a surface concrete pad 18 by 18 by 6 inches to protect valve box when valve is not located below pavement.
- B. Clean valve and curb stops interior before installation.
- C. Set valve and curb stop box cover flush with finished grade.
- D. Valves shall be installed plumb and level and in accordance with manufacturer's recommendations.

**3.11 SETTING OF FIRE HYDRANTS:**

- A. Set center of each hydrant not less than 2 feet nor more than 6 feet back of edge of road or face of curb. Fire apparatus connection shall face road with center of nozzle 18 inches above finished grade. Set barrel flange not more than 2 inches above finished grade.
- B. Set each hydrant on a slab of stone or concrete not less than 4 inches thick and 15 inches square. The service line to the hydrant, between the tee and the shoe of the hydrant, shall be fully restrained.
- C. Set bases in not less than 1/2 cubic yard of crushed rock or gravel placed entirely below hydrant drainage device.
- D. Clean interiors of hydrants of all foreign matter before installation.

**3.12 PIPE SLEEVES:**

Install where water lines pass through retaining walls, building foundations and floors. Seal with modular mechanical type link seal. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.

**3.13 FLUSHING AND DISINFECTING:**

- A. Flush and disinfect new water lines in accordance with AWWA C651.

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- B. Initial flushing shall obtain a minimum velocity in the main of 2.5 feet per second at 40 PSI residual pressure in water main. The duration of the flushing shall be adequate to remove all particles from the line.

Pipe Diameter	Flow Required to Produce 2.5 ft/sec (approx.) Velocity in Main	Number of Hydrant Outlets			
		Size of Tap. in. (mm)			
		1	1 ½	2	2 1/2-in
In	gpm	Number of taps on pipe			
4	100	1	--	--	1
6	200	--	1	--	1
8	400	--	2	1	1
10	600	--	3	2	1
12	900	--	--	3	2
16	1,600	--	--	4	2

The backflow preventers shall not be in place during the flushing.

- C. The Contractor shall be responsible to provide the water source for filling, flushing, and disinfecting the lines. Only potable water shall be used, and the Contractor shall provide all required temporary pumps, storage facilities required to complete the specified flushing, and disinfection operations.
- D. The Contractor shall be responsible for the disposal of all water used to flush and disinfect the system in accordance with all governing rules and regulations. The discharge water shall not be allowed to create a nuisance for activities occurring on or adjacent to the site.
- E. Following chlorination and after the entire length of line is ready for operation, all treated water shall be flushed thoroughly from the newly laid pipeline, at its extremities, until the replacement water throughout its length will upon test, both chemical and bacteriological, be proved equal to the quality introduced at the permanent source of supply. Samples for laboratory analysis shall be taken after water has stood in the main at least 24 hours following flushing. Should the initial treatment prove ineffective, the chlorination procedure shall be repeated as directed until confirmed tests show the water from the newly laid pipe conforms to the requirements of the preceding section. No newly laid water main may be placed into service until approval is given by the Contracting Officer's Representative.
- F. The bacteriological test specified in AWWA C651 shall be performed by a laboratory approved by the Health Department Department of Environmental Quality of the State. The cost of sampling,

transportation, and testing shall be the responsibility of the Contractor.

- G. Re-disinfection and bacteriological testing of failed sections of the system shall be the sole responsibility of the Contractor.
- H. Before backflow preventers are installed, all upstream piping shall be thoroughly flushed.

### **3.14 DISPOSAL OF HEAVILY CHLORINATED WATER**

- A. After the applicable retention period, heavily chlorinated water should not remain in contact with pipe for more than 48 hours. In order to prevent damage to the pipe lining or corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use.
- B. Heavily chlorinated water (greater than 0.5 mg/l residual) must be disposed of in a manner that conforms to all local, State and Federal regulations. Disposal may be to the sanitary sewer system or storm sewer system.
- C. If the Contractor elects to direct the heavily chlorinated water to the sanitary sewer system, the Contractor shall contact the local sewer department to ascertain any requirements for discharge. Any fees associated with discharge to the sanitary sewer system shall be included in the unit prices bid under Item 1.
- D. If the Contractor elects to direct the heavily chlorinated water to a storm sewer system, the chlorine residual of water being disposed shall be neutralized by treating with one of the reducing agents listed in Table 1. The amount of reducing agent applied shall be sufficient to lower the chlorine residual of the water disposed to 0.0 mg/l. If the Contractor elects to utilize a chemical for dechlorination, the water shall be aerated prior to discharge to the storm sewer system.

### **3.15 HYDROSTATIC TESTING:**

- A. Hydrostatic testing of the system shall occur prior to disinfecting the system.
- B. After new system is installed, except for connections to existing system and building, backfill at least 12 inches above pipe barrel, leaving joints exposed. The depth of the backfill shall be adequate to prevent the horizontal and vertical movement of the pipe during testing.
- C. Prior to pressurizing the line, all joint restraints shall be completely installed and inspected.



- D. If the system is tested in sections, and at the temporary caps at connections to the existing system and buildings, the Contractor shall provide and install all required temporary thrust restraints required to safely conduct the test.
- E. The Contractor shall install corporation stops in the line as required to purge the air out of the system. At the completion of the test, all corporation stops shall be capped.
- F. The Contractor shall perform pressure and leakage tests for the new system for 2 hours to 150 psi. Leakage shall not exceed the following requirements.
  - 1. Copper Tubing: No leaks.
  - 2. Ductile Iron Pipe: AWWA C600. Provide to COR office.

When a section of pipe of a length deemed adequate by the COR is ready for testing, the line shall be thoroughly blown free from air and a leakage test made. The pressure and leak tests shall be in accordance with AWWA Standard C600, latest revision. The work shall include furnishing all labor, materials, and equipment for carrying out these tests.

Unless otherwise required to meet working conditions, all new potable water pipelines shall be tested under a hydrostatic pressure of 150 pounds per square inch on the highest part of the section under test. The duration of each pressure test shall be at least two hours.

Joints that leak shall be repaired and retested under the same conditions and under the same period of operation. If joints are found to be defective, they shall be replaced until the line passes the required test.

Any cracked or broken pipe, fittings, or valves shall be removed and replaced with sound pieces.

Wherever conditions will permit, in the opinion of the Engineer, the pipes shall be tested before the trench is backfilled. All joints shall be examined during the open trench test and all visible leaks entirely stopped.

The Contractor shall be required to provide all pipe taps, gauges, and corporation stops, as well as any other materials and equipment necessary to expel all air and test the lines.

3. Polyvinyl Chloride (PVC) AWWA C605. Provide to COR office.

**3.16 BACKFLOW PREVENTOR TESTING:**

- A. All backflow preventers shall be tested and certified for proper operation prior to being placed in operation.
- B. Original copies of the certification shall be submitted to the COR.

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**SECTION 34 71 13**  
**VEHICLE BARRIERS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section includes passive High-Security Vehicle Barricades of walls and fixed bollards of crash resistance rating.

**1.2 RELATED WORK**

- A. Section 32 12 16, ASPHALT PAVING, for asphalt driveway and approach paving.
- B. Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS, for concrete driveway and approach paving.
- C. Section 03 30 53, CAST-IN-PLACE CONCRETE, for concrete islands and curbing.
- D. Section 05 50 00, METAL FABRICATIONS, for pipe bollards to protect parking control equipment.

**1.3 SYSTEM DESCRIPTION**

- A. Bollard system mounted in the ground as detailed on the drawings.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Indicate dimensions, required clearances, method of field assembly, and location and size of each field connection.
- C. Certificate test reports confirming compliance's with specified resistive rating.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain control equipment through one source from a single manufacturer.

**1.6 PERFORMANCE**

- A. Performance Evaluation. All passive vehicle barriers shall be certified for their resistance to ramming according to "Test Method of Vehicle Crash Testing of Perimeter Barriers and Gates" SD-STD-02.01 Revision A March 2003.

B. The system shall have been certified by the United States Department of State to have a performance evaluation per Department of State D.O.S. Specification SDSDT- 0201.

1. STOPPING CAPACITY.

2. Normal Operation. Vehicle barrier(s) shall provide excellent security and positive control of normal traffic in both directions by providing an almost insurmountable obstacle to non-armored or non-tracked vehicles.

3. The Vehicle barrier(s) system shall be designed to stop a vehicle attacking from either direction.

4. High Energy Attack. Vehicle barrier(s) shall have been shown by certified dynamic non-linear analysis to be capable of stopping and immobilizing non-armored or non-tracked vehicles with weight and velocity characteristics as defined in paragraph 4.3.2.1. The Bollard system shall be designed to destroy the front suspension system, steering linkage, engine crankcase and portions of the drive train.

5. The Vehicle barrier(s) shall be capable of stopping and destroying a vehicle(s) weighing: 15,000 pounds:

a. K4 = 30 mph

b. K8 = 40 mph

c. K12 = 50 mph

#### **1.7 COORDINATION**

Coordinate installation of anchorages for control equipment. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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

Department of State D.O.S. Specification SDSDT- 0201.

### **PART 3-EXECUTION**

#### **3.1 EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, critical dimensions, and other conditions affecting performance.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

Install Gate in concrete foundation pad as outlined in manufactures installation instructions.

### **3.3 FIELD QUALITY CONTROL**

Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

---END---