

# PROJECT MANUAL

## **PAD - Design Fisher House #2 Site Preparation Utilities & Landscaping**

Contract No. 640-16-112

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**Office of Construction and Facilities Management**

**100% CONSTRUCTION DOCUMENTS  
05/01/2017**



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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 construction operations, and furnish all labor, equipment and materials and perform work for the modification of the Fisher House Site, Utilities and Landscaping, Palo Alto, CA as required by the drawings and specifications.
- B. Visits to the VA Campus site by Bidders may be made only by appointment with the Contracting Officer's Representative.
- C. Offices of The KPA Group, 6700 Koll Center Parkway, Pleasanton, CA 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.
- D. Before placement and installation of work subject to tests by a testing laboratory approved by the COR and retained by the contractor, the Contractor shall notify the Contracting Officer's Representative and the testing laboratory in sufficient time to enable the COR and the 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 Contracting Officer's Representative.
- E. All employees of the Contractor and subcontractors shall comply with the VA security management program and obtain permission for site entry from the VA police, be identified by project and employer, and be restricted from unauthorized access.
- F. The Contracting Officer's Representative will assign specific routes and times for pathways, corridors and elevators for transportation of personnel, materials and equipment. The Contractor will continually clean-up any dust, dirt or debris caused by their jobsite Ingress/egress, and provide daily clean up prior to end of work shift.
- G. Dust and fume control will be exercised during all construction operations. Workers will be careful not to operate any vehicles, gas or diesel engines, or to perform any fume or dust generating process near a building air intake system. Noise will be held to a minimum at all times. Jack-hammering, core drilling and other noisy or disturbing Facility operations may have to be rescheduled or accomplished after

hours to avoid interfering with facility services at the contractor's own expense.

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

- A. ITEM I, GENERAL: Work includes site coordination.
- B. SCOPE OF WORK: The intent of the project will provide temporary pedestrian pathways & vehicular traffic for Fisher House #1 during construction activities, parking lot modifications over the Lands of the San Francisco Public Utility Commission (SFPUC), and construction of utility tie-ins for the future Fisher House #2 as shown on the Contract Documents.
- C. Additional Insurance Requirement to work inside the SFPUC Right of Way. The Requesting part the 'General Contractor' shall procure at his own expense and keep in effect, and cause its subcontractors, if any, performing the Work to procure, at its expense and keep in effect at all times during the term of this consent commercially reasonable insurance, adequate to cover Requesting Party's obligations under this consent, and shall name as additional insured the City and County of San Francisco and its Public Utilities Commission, and their respective officers, agents, volunteers and employees. Prior to commencement of the Work, and at the City's request at any time, General Contractor shall deliver to the COR and the City certificates of insurance evidencing the insurance coverage required by this consent, together with complete copies of the policies at City's request. The minimum coverage of insurance shall be as follows: (i) General Liability Insurance with limits not less than \$1,000,000 each occurrence combined single limit for bodily injury and property damage, including coverage for contractual liability, independent contractors, explosion, collapse and underground (XCU), personal injury, broadform property damage, products and completed operations; (ii) Automobile Liability Insurance not less than \$1,000,000 each occurrence combined single limit for bodily injury and property damage, including coverage for owned, non-owned and hired automobiles, as applicable, if Requesting Party or its contractor or any subcontractor uses or causes to be used any vehicles in connection with its performance of the Work or use of the property, and (iii) workers' compensation insurance with employer's liability coverage of not less than \$1,000,000 each accident. The workers' compensation policy shall be endorsed with a waiver of subrogation in favor of the City for all work performed by Requesting Party, its employees, agents, contractors and subcontractors.

Each certificate of insurance shall include a reference to the CST number To Be Determined (TBD) at time of request to work over the SFPUC right of way. (Provide 60 days' notice to the COR prior to request to work over the SFPUC). At all times, all policies shall be in form and content, and with coverage types and amounts satisfactory to the City's Risk Manager, and shall remain subject to City's periodic review of limits and types of insurance to be carried. All policies shall be endorsed to require thirty (30) days prior written notice to City of cancellation or intended non-renewal. Insurance companies shall be legally authorized to engage in the business of furnishing insurance in the State of California. All insurance companies shall have a current A.M. Best Rating no less than "A-, VIII" and shall be satisfactory to the City. In the event Requesting Party or its contractor or any subcontractor fails to procure such insurance, or to deliver such policies or certificates, City may procure, at its option, the same for the account of Requesting Party, and the cost thereof shall be paid to City by Requesting Party within five (5) days after delivery to Requesting Party of bills therefore.

### **1.3 SPECIFICATIONS AND DRAWINGS**

- A. After award of contract, specifications and drawings will be available for download from a link provided by the Contracting Officer's Representative
- B. The Contractor shall maintain on the job site one (1) printed set of specifications, one (1) printed set of drawings, one (1) printed copy of all RFI's and any documents that modify the original specifications and drawings.

### **1.4 ACCIDENT PREVENTION**

- A. The Contractor shall provide and maintain work environments and procedures which will:
  - 1. Safeguard the public and Government personnel, property, materials, supplies, and equipment exposed to Contractor operations and activities;
  - 2. Avoid interruptions of Government operations and delays in project completion dates;
  - 3. Control costs in the performance of this contract; and
  - 4. Maintain a safe and healthy worksite to prevent adverse impacts to Contractor and subcontractor employees.



B. The Contractor shall:

1. Before commencing the work, submit a written Safety Plan for implementing actions to prevent accidents. The plan shall include an analysis of significant hazards to life, limb and property inherent in contract work performance and measures for controlling these hazards and avoiding personnel exposure. Meet with the Contracting Officer's Representative to discuss and develop a mutual understanding relative to administration of the overall safety program and obtain approval for the Contractor's Safety Plan from the Contracting Officer's Representative before work start.
2. Comply with the standards issued by the Secretary of Labor at 29 CFR Part 1926 and 29 CFR Part 1910 (OSHA); and Title 8, California Administrative Code - Construction Standards (CAL OSHA)
3. Prior to commencing work, provide proof that an OSHA designated competent person (CP) per 29 CFR 1926.20(b)/ 1926.32(f)(2) will maintain a presence at the work site whenever the Contractor or subcontractors are present. OSHA designated competent person shall possess an OSHA 30 Construction Safety Course certificate at a minimum.
4. Provide OSHA and CAL-Trans approved safety barricades, signs, signal lights, and personal protective equipment (hard hats, goggles, protective shoes, gloves, masks or breathing apparatus, etc.).
5. Ensure all Contractor and subcontractor employees have the 10-hour or 30-hour OSHA Construction Safety course and other relevant competency training, as determined by Contracting Officer's Representative. General Contractor shall maintain at least one Competent Person (CP) on site at all times who has completed the 30 hours OSHA Construction Safety Course (submittal of 30 hour training certificate for designated Site Competent Person required prior to start of project, and before commencement of work day when substituted by an alternate CP). Submit minimum 10 hour OSHA training records for approval of all contractor and sub-contractor employees prior to start of work.
6. Ensure that any additional measures the Contracting Officer determines to be reasonably necessary for accident protection and safety of personnel are taken.

C. Whenever the Contracting Officer becomes aware of any noncompliance with safety requirements or any condition which poses a serious or imminent danger to the health or safety of personnel, the Contracting Officer

shall notify the Contractor orally, with written confirmation, and request immediate initiation of corrective action. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall not be entitled to any equitable adjustment of the contract price or extension of the performance schedule on any stop work order issued under this clause.

- D. The Contractor shall insert the above clause with appropriate changes in the designation of the parties in subcontracts.

#### **1.5 CONSTRUCTION SECURITY REQUIREMENTS**

- A. Security Plan (Submittal of Security Plan is required prior to mobilization):

1. The Security Plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
2. The 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. Contractor and subcontractor employees shall not enter the project site without an appropriate badge. They will be subject to inspection of their personal effects when entering or leaving the project site.
2. The Contractor shall create an Employee Daily Log of all personnel working on the site. The Employee Daily Log shall contain the employee's (a) Full Name, (b) Employer/Company Name and (c) Occupation/Trade. The Employee Daily Log shall be submitted with the Contractor's Daily Work Report.
3. Contractor's normal working hours shall be 7am to 4pm Monday through Friday excluding federally observed holidays, unless noted otherwise.
  - I. Contractor must observe all Federal Holidays with no work allowed on such days. Refer to the OPM website [www.opm.gov](http://www.opm.gov) for the observed Federal Holidays and their dates for the applicable year.
  - a. Contractor must obtain written prior approval by the COR to work outside of normal working hours and weekends. This notice is separate from any notices required for utility shutdown described later in this specification.

4. No photography of VA premises is allowed without written permission of the VA Public Affairs Officer.
5. The VA Police are Federal Police Officers with full authority to make arrests, investigate crimes, and issue traffic citations. Citations issued require an appearance in the Federal District Court and/or payment of a fine. Speed limits and other driving and parking codes are strictly enforced. Any vehicle left unattended for more than a few minutes may be cited by the VA Police.
6. Sexual harassment is strictly prohibited. This includes deliberate or unsolicited verbal comments or gestures of a sexual nature, unwelcome sexual advances, requests for sexual favors and/or other unwelcome verbal or physical conduct of a sexual nature.
7. Possession or use of non-prescription drugs or alcohol, including beer and wine, on the Health Care System grounds is strictly prohibited. Possession of firearms, knives with blades over 4", ammunition, explosive devices and any item that may be considered an offensive weapon is strictly prohibited. This includes carrying such items in vehicles.
8. The Health Care System does not have the equipment, facilities, or personnel trained to handle serious injuries. Call 911 for emergency medical assistance and notify the Contracting Officer's Representative and the VA Police.
9. Vehicle authorization requests shall be required for any contractor vehicle entering the site and such requests shall be submitted 24 hours before the date and time of access. Access shall be restricted to picking up and dropping off materials and supplies.
10. VA reserves the right to shut down the project site and order Contractor's employees and subcontractors off the premises in the event of a national emergency or local disaster. The Contractor may return to the site only with the written approval of the Contracting Officer's Representative.

C. Guards: NOT USED

D. Key Control:

1. The Contractor shall provide duplicate keys and lock combinations to the Contracting Officer's Representative for the purpose of security inspections and emergency actions for every area of the project site including tool boxes and parked machines.
2. The Contractor shall turn over all permanent lock cylinders to the VA locksmith for permanent installation.

E. Document Control:

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

**1.5 FIRE SAFETY**

A. Applicable Publications: Publications listed below form part of this Article.

1. American Society for Testing and Materials (ASTM):  
E84-13a.....Surface Burning Characteristics of Building  
Materials
2. National Fire Protection Association (NFPA):  
NFPA 10.....Standard for Portable Fire Extinguishers

NFPA 30.....Flammable and Combustible Liquids Code  
NFPA 51.....Standard for Fire Prevention During Welding,  
Cutting and Other Hot Work  
NFPA 70/NEC.....National Electrical Code  
NFPA 241.....Standard for Safeguarding Construction,  
Alteration, and Demolition Operations

3. Occupational Safety and Health Administration (OSHA):

29 CFR 1910/1926.....Safety and Health Regulations for Construction

B. Fire Safety Plan (Submittal acceptance by COR of Fire Safety Plan is required prior to mobilization):

Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to Contracting Officer's Representative for review for compliance with contract requirements. Prior to any worker for the Contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the Contractor's competent person per OSHA requirements. This briefing shall include information on the construction limits, VA safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VA equipment, etc. Documentation shall be provided to the Contracting Officer's Representative that individuals have undergone Contractor's safety briefings.

C. Site Access: Maintain free and unobstructed access to facility emergency services and fire, police and other emergency response forces in accordance with NFPA 241. In the event of a fire or during a fire drill, the Contractor must vacate the construction site if within the zone affected.

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 exposed overall length, separate by 10 feet.

E. Temporary Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.

F. Means of Egress: Do not block exiting for occupied buildings including paths from exits to roads. Minimize disruptions and coordinate with Contracting Officer's Representative.

G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily and report findings and corrective actions weekly to Contracting Officer's Representative.

- H. Fire Extinguishers: Provide, maintain and show proof of extinguisher maintenance in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10. Provide minimum of (2) 10 pound fire extinguishers at all times. Provide 'Site' 10 pound ABC fire extinguishers on 'Dead Man' posts every 300 feet on center around site perimeter.
- I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- K. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers.
- L. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection and fire alarm systems except for portions immediately under construction or temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. If a Fire Alarm system or sprinkler system is out of service for more than 4 hours, then the Contractor shall implement Interim Life Safety Measures in accordance with VA Palo Alto Health Care System Memorandum SAFE 13-23. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with Contracting Officer's Representative. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the Contracting Officer's Representative.
- N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51. Any welding, cutting metal or other burning or spark producing operations require a hot work permit. Welding and/or burning operations are allowed only during normal working hours. Coordinate with Contracting Officer's Representative to obtain permits from the Facility Safety Officer at least 24 hours in advance. Evidence of training of all personnel assigned to be a fire watch shall be provided before Hot Work Permits will be issued. A fire watch is required for all hot work unless specified differently on the permit. The fire watch shall have fire extinguishing equipment readily available and be trained in its use and be familiar with facilities for sounding an alarm in the event of a fire. They shall watch for fires in all exposed areas, try to extinguish then otherwise sound the alarm. A fire watch shall be maintained for at least 30 minutes after completion of hot work.

- O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas daily. Coordinate with and report findings and corrective actions weekly to Contracting Officer's Representative.
- P. Smoking: Smoking is prohibited on Campus except in designated smoking areas, including all buildings, and adjacent construction areas.
- Q. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily. Waste and debris will not be disposed of on station or in VA trash containers or dumpsters. The Contractor shall provide their own bin or dumpster; however, the use and location of such must be approved in writing by the Contracting Officer's Representative. Dumpsters must be covered with an approved dumpster cover during rain events. Construction waste and debris will not be accumulated in corridors or other building areas where it might cause a fire or safety hazard. Contractor shall provide a 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 per SECTION 01 74 19 CONSTRUCTION WASTE MANAGEMENT.
- S. If required, submit documentation to the Contracting Officer's Representative 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's Representative. 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's Representative 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 their expense upon completion of the work. With the written consent of the Contracting Officer's Representative, the buildings and utilities may be abandoned and need not be removed.
- C. The Contractor shall, as prescribed by the Contracting Officer's Representative, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting

Officer's Representative. 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, code or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall at his own cost 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 Contracting Officer's Representative.
- E. Workmen are subject to rules of the VA Campus applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of the VA Campus as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.
  - 1. Do not store materials and equipment in other than assigned areas.
  - 2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by the VA in quantities sufficient for not more than two work days. Provide unobstructed access to VA Campus areas required to remain in operation.
- G. Utilities Services: Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems, they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by Contracting Officer's Representative. All such actions shall be coordinated with any Utility Company involved. All utility service disruptions to facility operations shall be coordinated with the COR and shall occur on weekends or after normal business hours as directed by the COR, provide 45 days' notice for all utility service disruptions to the facility.
- H. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, six-foot minimum height, around the construction area, material storage areas, and dumpsters/waste locations. All construction site fence posts shall be installed secured to the ground by embedded posts or embedded rebar dowels (#4 rebar -4ft embedment & 3ft above ground - at each fence



post)- at no time shall metal fence station bases or concrete pier blocks be used. Contractor shall provide and maintain visual screening fabric for all fencing (screens shall be adequately vented for wind). Contractor shall provide gates as required for access with necessary hardware including hasps and locks. All gates shall be closed at all times except for required passage through gates, and gates shall be locked when workers are not present at site. Contractor shall coordinate with the COR to assure VA access at any time. Contractor shall remove the fence when directed by Contracting Officer's Representative.

Contractor shall place all applicable safety signs as required by 29 CFR 1926, securely attached to fence or approved surface. Contractor shall also place construction area signs on the exterior of the construction fence alerting campus and contractor personnel that the fence is enclosing a construction area. Sign shall indicate Construction Area, Authorized Personnel Only, Hard Hats, eye protection, and safety shoes required - Spacing of signs shall not exceed 50' on center, with a minimum of one safety sign on each direction of fence. Provide LED light strip, continuous, on top of fence and light during dark hours of day.

- I. Work areas will be vacated by Government and turned over to Contractor after the date of Notice to Proceed, and all pre-construction activities and required submittals have been accepted by the COR.
- J. When a building/ area are turned over to Contractor, Contractor shall accept entire responsibility therefore.
  - 1. Contractor shall maintain a minimum temperature of 50 degrees F at all times, except as otherwise specified.
  - 2. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, Contractor shall make arrangements for pre-inspection of site with Fire Department or Company (VA or municipal) whichever will be required to respond to an alarm from Contractor's employee or watchman.
- K. Utilities Services: Maintain existing utility services for the VA Campus at all times.
  - 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 Contracting Officer's Representative. 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 a contractor submitted, COR approved safety plan, and written approval from the COR to proceed. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 27 05 11 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS for additional requirements.
2. Contractor shall submit a request to interrupt any such services to Contracting Officer's Representative, in writing, 45 days in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
  3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of the VA. Interruption time approved by Contracting Officer's Representative may occur at other than Contractor's normal working hours at the contractor's own expense.
  4. Major interruptions of any system must be requested, in writing, at least 45 calendar days prior to the desired time and shall be performed as directed by the Contracting Officer's Representative.
  5. In case of a contract construction emergency, service will be interrupted on approval of Contracting Officer's Representative. 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 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 VA Campus traffic, comply with the following:
1. The Contractor shall not block any road or street, walkway or building egress without requesting in writing for approval from the Contracting Officer's Representative. Written requests shall be made at least (30) days prior to proposed interruption. Keep roads, walks and entrances to grounds, to parking and to occupied areas of

- buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new work crosses existing roads, at least one lane must be open to traffic at all times.
2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the Contracting Officer's Representative.
- N. Coordinate this contract with other construction operations as directed by Contracting Officer's Representative. This includes the scheduling of traffic and the use of roadways.

#### **1.7 ALTERATIONS**

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the Contracting Officer's Representative, of buildings areas in which alterations occur and areas which are anticipated routes of access, and furnish a signed report, to the Contracting Officer's Representative. This report shall list by rooms and spaces:
1. Existing condition and types of flooring, doors, windows, walls, and other surfaces not required to be altered throughout affected areas of the building.
  2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, window blinds, fabric shades, etc., required by drawings to be either reused or relocated, or both.
  3. Shall note any discrepancies between drawings and existing conditions at site.
  4. Shall designate areas the areas agreed upon by the Contracting Officer's Representative all project working space, materials storage, and routes of access to areas within buildings where alterations occur.
- 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 Contracting Officer's Representative 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 Contracting Officer's Representative together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of resilient flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:
1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:
1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.
  2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
  3. Protection of all interior existing structures, furniture, fixtures, and equipment at all times, from damage, dust and weather. 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 VA'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 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 Contracting Officer's Representative and Facility ICRA team for review for compliance with contract requirements.
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. VA Infection Control personnel shall monitor for airborne disease (e.g. aspergillosis) as appropriate during construction. A baseline of conditions may be established by the Contracting Officer's Representative prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality. In addition in patient-care areas:

1. The Contractor, Contracting Officer's Representative and VA Infection Control personnel shall review pressure differential monitoring documentation to verify that pressure differentials in the construction zone and in patient-care areas are appropriate for their settings. The requirement for negative air pressure in the construction zone shall depend on the location and type of activity. Upon notification, the contractor shall implement corrective measures to restore proper pressure differentials as needed. The contractor shall install negative air machines as directed by the Contracting Officer's Representative and shall be required to add machines as directed.
2. In case of a problem - the VA, with assistance from the contractor, shall conduct an environmental assessment to find and eliminate the source.

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

1. Dampen debris to keep down dust and provide temporary construction partitions in existing structures where directed by Contracting Officer's Representative. Blank off ducts and diffusers to prevent circulation of dust into patient-occupied areas during construction.
2. Do not perform dust producing tasks within patient-occupied areas without the approval of the Contracting Officer's Representative. For construction in any areas that will remain jointly occupied by the medical Center and Contractor's workers, the Contractor shall:
  - a. Provide dust proof temporary drywall construction barriers to completely separate construction from the operational areas of the hospital in order to contain dirt debris and dust. Construct the dust proof barrier with a one hour fire rating. Barriers shall be sealed and made presentable on hospital occupied side. Install a self-closing rated door in a metal frame, commensurate with the partition, to allow worker access. Maintain negative air at all times. A fire retardant polystyrene, 6-mil thick or greater plastic barrier meeting local fire codes may be used in certain

circumstances where hard walls cannot be constructed and an agreement is reached with the Contracting Officer's Representative and VA Fire Protection Specialist.

- b. HEPA filtration is required. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. Install HEPA (High Efficiency Particulate Accumulator) filter vacuum system rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. Insure continuous negative air pressures occurring within the work area. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Exhaust hoses shall be heavy duty, flexible steel reinforced and exhausted so that dust is not reintroduced to the medical center.
- c. The contractor shall install a state of the art air pressure differential monitor. The monitor shall be placed at such a location that anyone entering or leaving the work site shall be able to determine if negative air pressure is being maintained.
- d. Adhesive Walk-off/Carpet Walk-off Mats, minimum 24" x 36", shall be used at all interior transitions from the construction area to occupied medical center area. A shop vacuum with HEPA filtration shall be placed at any exit from the work site. These shop vacuums shall be used to remove dust that has accumulated on workers clothing while working whenever they leave the work site. The mats shall be changed as directed by the Contracting Officer's Representative to maintain clean work areas directly outside construction area at all times.
- e. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Shop vacuums and vacuum cleaners shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as they are created. Transport these outside the construction area in containers with tightly fitting lids.
- f. The contractor shall not haul debris through patient-care areas without prior approval of the Contracting Officer's Representative. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with tape. No sharp objects should be allowed to cut through the plastic. Wipe down the wheel treads and 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. Wheels and tires shall not track debris on floors outside the work zone.

- g. Using a HEPA vacuum, clean inside the barrier and vacuum ceiling tile prior to replacement. Any ceiling access panels opened for investigation beyond sealed areas shall be sealed immediately when unattended.
- h. 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 4 hours. Remove and dispose of porous materials that remain damp for more than 24 hours.
- i. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.

E. Final Cleanup:

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

**1.9 DISPOSAL AND RETENTION**

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

- 1. Reserved items which are to remain property of the Government are noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed from present locations in such a manner as to prevent damage. Store such items where directed by Contracting Officer's Representative.
- 2. Items not reserved shall become property of the Contractor and be removed by Contractor.
- 3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by

the VA during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.

4. The Contractor is required to alert the VA immediately in the event any known or suspected hazardous materials are disturbed or will need to be disturbed before proceeding with work. Hazardous materials, such as PCB's, asbestos, lead paint, cleaning solutions and other harmful chemicals shall be disposed of in accordance with federal, state and local laws and regulations. In case of an accidental spill of hazardous materials, the Contractor shall take immediate action to contain the spill and notify the Contracting Officer's Representative. Washing cement, plaster, paint, oil or grease, solvents, etc. into any drains is strictly prohibited. **REPORT ANY ACCIDENTAL SPILLS THAT MAY RUN INTO STORM DRAINS IMMEDIATELY TO ENGINEERING SERVICE AT 650-493-5000 EXTENSION 62468.**

#### **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 as directed by the Contracting Officer's Representative.
- B. Contractor shall protect all irrigation equipment designated to remain within the limit of work and ensure the continued irrigation of all existing planting areas to remain in place.
- C. *The project construction may affect irrigation operations beyond the limit of work.* It shall be the responsibility of the Contractor to ensure the irrigation operations beyond the limit of work, affected by the project construction, remain operational during construction.
- D. The Contractor shall protect existing trees to remain by placing temporary fencing at the drip line of the trees. Provide 6' high tree protection fencing completely enclosing the tree(s). Avoid driving major fence posts or stakes into major roots.



1. No stockpiling of materials, vehicular traffic, or storage is allowed within the tree protection zone.
  2. No equipment or machinery shall be used within the tree protection zone. Work within the protection zone shall be done manually.
  3. Treatment of roots exposed during construction. For roots over 1 inch in diameter damaged during construction, make a clean straight cut to remove damaged portion of the root. All exposed roots should be temporary covered with damp burlap and covered with soil or mulch as soon as possible to prevent drying.
- E. 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's Representative may have the necessary work performed and charge the cost to the Contractor.

#### **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 Contracting Officer's Representative. Existing work to be altered or extended and that which is found to be defective in any way, shall be reported to the Contracting Officer's Representative 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, plants & irrigation system, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing

pipings and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone, computer network, etc.) which are indicated on drawings or reasonably discovered during execution of the work and which are not scheduled for discontinuance or abandonment.

- D. Expense of repairs to such utilities and systems not shown on drawings for which locations are unknown and not reasonably discovered will be considered for 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 (test borings, hydrographic data, test pits, weather conditions, etc.) furnished or referred to 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. (FAR 52.236-4)

#### **1.13 LAYOUT OF WORK**

- A. The Contractor shall lay out the work and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all templates, 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 that may be established or indicated by the Contracting Officer's Representative. The Contractor shall also be responsible for maintaining and preserving all marks established by the Contracting Officer's Representative 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's Representative 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)

#### **1.14 AS-BUILT DRAWINGS**

- A. The Contractor shall maintain one full size set 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 Contracting Officer's Representative's review, as often as requested.

- C. Contractor shall deliver two approved completed sets of as-built drawings to the Contracting Officer's Representative within 15 calendar days after each completed phase and after the acceptance of the project by the Contracting Officer's Representative.

Contractor shall provide all final as-built drawings prepared in approved Autodesk AutoCAD compatible software. An electronic copy shall be delivered to the COR in both DWG format and PDF along with the two hard copy sets. Drawing size, style, and fonts shall match construction drawings provided to the contractor by the contracting officer.

Coordinate with COR for allowable version of DWG files.

#### **1.15 USE OF ROADWAYS**

- A. For hauling, use only established public roads and roads on the VA Campus and, when authorized by the Contracting Officer's Representative, 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 transitions.

#### **1.16 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 Contracting Officer's Representative. If the equipment is not installed and maintained in accordance with the following provisions, the Contracting Officer's Representative 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 use and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.
  3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.

4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage.
  5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.
  6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government. Boilers, pumps, feedwater heaters and auxiliary equipment must be operated as a complete system and be fully maintained by operating personnel. Boiler water must be given complete and continuous chemical treatment.
- B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.
- C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

**1.17 EXCLUSIVE TEMPORARY USE OF EXISTING ELEVATORS**

- A. Exclusive use of existing elevators for handling building materials and Contractor's personnel will be permitted subject to following provisions:
1. Contractor shall coordinate all arrangements with the Contracting Officer's Representative for use of elevators. The Contracting Officer's Representative will ascertain that elevators are in proper condition. Personnel for operating elevators will not be provided by the VA.
  2. Contractor covers and provides maximum protection of following elevator components:
    - a. Entrance jambs, heads soffits and threshold plates.
    - b. Entrance columns, canopy, return panels and inside surfaces of car enclosure walls.
    - c. Finish flooring.
  3. Government will accept hoisting ropes of elevator and rope of each speed governor if they are worn under normal operation. However, if these ropes are damaged by action of foreign matter such as sand,

lime, grit, stones, etc., during temporary use, they shall be removed and replaced by new hoisting ropes.

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

#### **1.18 TEMPORARY TOILETS**

- A. Provide where directed, (for use of all Contractor and subcontractor employees) ample temporary sanitary toilet accommodations with suitable sewer and water connections; or, when approved by Contracting Officer's Representative, provide suitable dry closets where directed. Keep such places clean and free from odor or flying insects, 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. If applicable, 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. If temporary construction power is not reasonably available or accessible, contractor shall provide a temporary power generator capable of supporting all construction power requirements at his own expense.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Contracting Officer's Representative, shall install and maintain all necessary temporary connections, distribution lines, transformers, and electrical panels, 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 equipment at contractor's own expense.

- C. Contractor shall install meters at Contractor's expense and furnish the Contracting Officer's Representative a monthly record of the Contractor's usage of electricity prior to approval to submit the contractor's monthly pay application to the VA's Contactor Payment system.
- 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 VA Campus electrical distribution system where practical. 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.
  - 2. Where Campus power is not practical or available for project power requirements, contractor shall provide portable power generators at contractor's own expense.
- F. Water (for Construction and Testing): Furnish temporary water service.
  - 1. Obtain water by connecting to the VA Campus 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 Contracting Officer's Representative's discretion) of use of water from VA Campus system at no cost.
  - 3. Provide drinking water for construction personnel at all times.
- G. 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 or reimbursed by the Contractor at Contractor's expense.

**1.20 NEW TELEPHONE EQUIPMENT**

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

**1.21 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 the Contracting Officer's Representative. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests, and re-tests as required.
- 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 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.

**1.22 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 (two copies each plus pdf file) for each separate piece of equipment shall be delivered to the Contracting Officer's Representative 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 manufacturer representatives to give detailed instructions to assigned VA personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the Contracting Officer's Representative and shall be considered concluded only when the Contracting Officer's Representative is satisfied in regard to complete and thorough coverage. The VA reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the Contracting Officer's Representative, does not demonstrate sufficient qualifications in accordance with requirements for the above.

#### **1.23 GOVERNMENT-FURNISHED PROPERTY**

- A. The Government shall deliver to the Contractor, the Government-furnished property shown on the drawings.
- B. Equipment furnished by Government to be installed by Contractor will be furnished to Contractor at the building.



- C. Storage space for equipment will be provided by the Government and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the building.
- D. Notify Contracting Officer's Representative in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.
  - 1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with the Contracting Officer's Representative. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Contracting Officer's Representative with a written statement as to its condition or shortages.
  - 2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Contracting Officer's Representative.
- E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the Contractor at no additional cost to the Government.
- F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.
- G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

**1.24 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 Contracting Officer's Representative.
- C. 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.

#### **1.25 CONSTRUCTION SIGN**

- A. Provide a Construction Sign where directed by the Contracting Officer's Representative. 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. Minimum sign size shall be 48"x48".
- 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 Contracting Officer's Representative.
- D. Provide detailed drawing of proposed construction sign showing required legend and other characteristics of sign for approval by the Contracting Officer's Representative - COR may provide examples of previously approved signs.

#### **1.26 SAFETY SIGN**

- A. Provide a Safety Sign where directed by Contracting Officer's Representative. 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. Minimum sign size shall be 48"x48".
- 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 and approved by Contracting Officer's Representative.
- C. Maintain sign and remove it when directed by Contracting Officer's Representative.
- D. Provide detailed drawing of proposed sign showing required legend and other characteristics of sign for approval by the Contracting Officer's Representative - COR may provide examples of previously approved signs.
- E. Post the number of accident free days on a daily basis.

**1.27 PHOTOGRAPHIC DOCUMENTATION**

- A. Contractor to provide digital photographic exhibit of existing site and work performed. Digital color photos shall be taken from a digital camera with a minimum of 7.0 megapixels. Photos shall be transmitted to the COR by DVD in jpeg or tiff, and PDF formats. Each photo's electronic file size shall be a minimum of 300k with a maximum file size of 1.5meg.
- B. Photos shall document all phases of construction and shall be updated weekly until the project has been completed. A minimum of five (5) Photos shall be taken during each work day. Photos shall be submitted each month along with the project invoice for monthly payment.

**1.28 FINAL ELEVATION DIGITAL IMAGES - NOT USED**

**1.29 HISTORIC PRESERVATION**

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

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**SECTION 01 32 16.15**  
**PROJECT SCHEDULES**

**PART 1- GENERAL**

**1.1 DESCRIPTION:**

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

**1.2 CONTRACTOR'S REPRESENTATIVE:**

- A. The Contractor shall designate an authorized representative responsible for the Project Schedule including preparation, review and progress reporting with and to the Contracting Officer's Representative (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 765 x 1070 mm (30 x 42 inches) and an electronic file in the previously approved

CPM schedule program. The submittal shall also include three copies of a computer-produced activity/event ID schedule showing project duration; phase completion dates; and other data, including event cost. Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, activity/event description, duration, budget amount, early start date, early finish date, late start date, late finish date and total float. Work activity/event relationships shall be restricted to finish-to-start or start-to-start without lead or lag constraints. Activity/event date constraints, not required by the contract, will not be accepted unless submitted to and approved by the Contracting Officer. The contractor shall make a separate written detailed request to the Contracting Officer identifying these date constraints and secure the Contracting Officer's written approval before incorporating them into the network diagram. The Contracting Officer's separate approval of the Project Schedule shall not excuse the contractor of this requirement. Logic events (non-work) will be permitted where necessary to reflect proper logic among work events, but must have zero duration. The complete working schedule shall reflect the Contractor's approach to scheduling the complete project. **The final Project Schedule in its original form shall contain no contract changes or delays which may have been incurred during the final network diagram development period and shall reflect the entire contract duration as defined in the bid documents.** These changes/delays shall be entered at the first update after the final Project Schedule has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.

- D. Within 30 calendar days after receipt of the complete project interim Project Schedule and the complete final Project Schedule, the Contracting Officer or his representative, will do one or both of the following:
1. Notify the Contractor concerning his actions, opinions, and objections.
  2. A meeting with the Contractor at or near the job site for joint review, correction or adjustment of the proposed plan will be

scheduled if required. Within 14 calendar days after the joint review, the Contractor shall revise and shall submit three blue line copies of the revised Project Schedule, three copies of the revised computer-produced activity/event ID schedule and a revised electronic file as specified by the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.

- E. The approved baseline schedule and the computer-produced schedule(s) generated there from shall constitute the approved baseline schedule until subsequently revised in accordance with the requirements of this section.
- F. The Complete Project Schedule shall contain approximately fifty 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 for guarantee period services, test, balance and adjust various systems in accordance with the provisions in Article, FAR 52.232 - 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.236 - 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS).
- C. In accordance with FAR 52.236 - 1 (PERFORMANCE OF WORK BY THE CONTRACTOR) and VAAR 852.236 - 72 (PERFORMANCE OF WORK BY THE CONTRACTOR), the Contractor shall submit, simultaneously with the cost per work activity/event of the construction schedule required by this



Section, a responsibility code for all activities/events of the project for which the Contractor's forces will perform the work.

- D. The Contractor shall cost load work activities/events for all BID ITEMS including ASBESTOS ABATEMENT. The sum of each BID ITEM work shall equal the value of the bid item in the Contractors' bid.

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

- A. Show on the project schedule the sequence of work activities/events required for complete performance of all items of work. The Contractor Shall:
1. Show activities/events as:
    - a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
    - b. Contracting Officer's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
    - c. Interruption of VA Facilities utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
    - d. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
    - e. VA inspection and acceptance activity/event with a minimum duration of five work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase.
  2. Show not only the activities/events for actual construction work for each trade category of the project, but also trade relationships to indicate the movement of trades from one area, floor, or building, to another area, floor, or building, for at least five trades who are performing major work under this contract.
  3. Break up the work into activities/events of a duration no longer than 20 work days each or one reporting period, except as to non-construction activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the 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 an application and certificate for payment using VA Form 10-6001a 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 Contracting Officer Representative 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 Contracting Officer Representative. 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 Contracting Officer Representative within fourteen (14) calendar days of completing the regular schedule update. **Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.**
- D. Following approval of the CPM schedule, the VA, the General Contractor, its approved CPM Consultant, RE office representatives, and all subcontractors needed, as determined by the SRE, shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of project schedule and to identify any necessary actions required to maintain project schedule during the reporting period. The Government representatives and the Contractor should conclude the meeting with a clear understanding of those work and administrative actions necessary to maintain project schedule status during the reporting period. This schedule coordination meeting will occur after each monthly project schedule update meeting utilizing the resulting schedule reports from that schedule update. If the project is behind schedule, discussions should include ways to prevent

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

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

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

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

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

- B. CPM revisions made under this paragraph which affect the previously approved computer-produced schedules for Government furnished equipment, vacating of areas by the VA Facility, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, shall be furnished in writing to the Contracting Officer for approval.
- C. Contracting Officer's approval for the revised project schedule and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the VA representative.
- D. The cost of revisions to the project schedule resulting from contract changes will be included in the proposal for changes in work as specified in FAR 52.243 - 4 (Changes) and VAAR 852.236 - 88 (Changes - Supplemental), and will be based on the complexity of the revision or contract change, man hours expended in analyzing the change, and the total cost of the change.
- E. The cost of revisions to the Project Schedule not resulting from contract changes is the responsibility of the Contractor.

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

- A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, CPM data and supporting evidence as the COR may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in this request. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer-produced calendar-dated schedule for the time period in question and all other relevant information.
- B. Actual delays in activities/events which, according to the computer-produced calendar-dated schedule, do not affect the extended and predicted contract completion dates shown by the critical path in

the network, will not be the basis for a change to the contract completion date. The Contracting Officer will within a reasonable time after receipt of such justification and supporting evidence, review the facts and advise the Contractor in writing of the Contracting Officer's decision.

- C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under FAR 52.243 - 4 (Changes) and VAAR 852.236 - 88 (Changes - Supplemental). The Contractor shall include, as a part of each change order proposal, a sketch showing all CPM logic revisions, duration (in work days) changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.
- D. All delays due to non-work activities/events such as RFI's, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month by month basis.

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**SECTION 01 33 23**

**SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES**

**PART1 - GENERAL**

**1.1 RELATED WORK**

- A. 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 DEFINITIONS**

- B. 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 referenced requirements. The following text refers to all items collectively as SUBMITTALS.

**1.3 SUBMITTAL PROCEDURES**

- A. 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:
1. Satisfactory written evidence is presented to, and approved by Contracting Officer's Representative, that manufacturer cannot make scheduled delivery of approved item or;
  2. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
  3. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- B. 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.
- C. Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by Contracting Officer's Representative on behalf of the Contracting Officer.
- D. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to

this file and identification number to expedite replies relative to previously approved or disapproved submittals.

- E. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefore by Contracting Officer's Representative, 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.
- F. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer's Representative and Architect-Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- G. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer's Representative assumes no responsibility for checking quantities or exact numbers included in such submittals.
  - 1. Submit samples required by Section 09 06 00, SCHEDULE FOR FINISHES, in quadruplicate (3 copies to Architect-Engineer, 1 copy to COR). Submit other samples in (2) two units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
  - 2. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via electronic 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.
    - a. 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.
    - b. 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.

c. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.

H. In addition to complying with the applicable requirements specified in preceding Paragraph G, 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's Representative.

1. Laboratory shall furnish Contracting Officer's Representative 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 by the contractor to approved commercial testing laboratory.
4. Contractor shall send a copy of transmittal letter to both Contracting Officer's Representative and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
5. Laboratory test reports shall be sent directly by testing agency to Contracting Officer's Representative 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.

I. 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.

J. Approved samples will be kept on file by the Contracting Officer's Representative

K. 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 PDF.
2. Reproducible shall be full size.
3. Each drawing shall have marked thereon, proper descriptive title, including Medical Center location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
5. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.

L. Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to:

The KPA Group  
1 Kaiser Plaza, Suite 445  
Oakland, California 94612

M. At the time of transmittal to the Architect-Engineer, the Contractor shall also send no copy of the complete submittal directly to the Contracting Officer's Representative.

## **PART 2 - PRODUCTS**

Not Used

## **PART 3 - EXECUTION**

Not Used

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**SECTION 01 35 26**  
**SAFETY REQUIREMENTS**

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**SECTION 01 35 26**  
**SAFETY REQUIREMENTS**

**1.1 APPLICABLE PUBLICATIONS:**

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

B. American Society of Safety Engineers (ASSE):

A10.1-2011.....Pre-Project & Pre-Task Safety and Health  
Planning

A10.34-2012.....Protection of the Public on or Adjacent to  
Construction Sites

A10.38-2013.....Basic Elements of an Employer's Program to  
Provide a Safe and Healthful Work Environment  
American National Standard Construction and  
Demolition Operations

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

E84-2013.....Surface Burning Characteristics of Building  
Materials

D. The Facilities Guidelines Institute (FGI):

FGI Guidelines-2010Guidelines for Design and Construction of  
Healthcare Facilities

E. National Fire Protection Association (NFPA):

10-2013.....Standard for Portable Fire Extinguishers  
30-2012.....Flammable and Combustible Liquids Code  
51B-2014.....Standard for Fire Prevention During Welding,  
Cutting and Other Hot Work  
70-2014.....National Electrical Code  
70B-2013.....Recommended Practice for Electrical Equipment  
Maintenance  
70E-2012 .....Standard for Electrical Safety in the Workplace  
99-2012.....Health Care Facilities Code  
241-2013.....Standard for Safeguarding Construction,  
Alteration, and Demolition Operations

F. The Joint Commission (TJC)

TJC Manual .....Comprehensive Accreditation and Certification  
Manual

G. U.S. Nuclear Regulatory Commission

10 CFR 20 .....Standards for Protection Against Radiation

H. U.S. Occupational Safety and Health Administration (OSHA):

29 CFR 1904 .....Reporting and Recording Injuries & Illnesses  
29 CFR 1910 .....Safety and Health Regulations for General  
Industry  
29 CFR 1926 .....Safety and Health Regulations for Construction  
Industry  
CPL 2-0.124.....Multi-Employer Citation Policy

I. VHA Directive 2005-007

## 1.2 DEFINITIONS:

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



### **1.3 REGULATORY REQUIREMENTS:**

- A. In addition to the detailed requirements included in the provisions of this contract, comply with 29 CFR 1926, comply with 29 CFR 1910 as incorporated by reference within 29 CFR 1926, comply with ASSE A10.34, and all applicable [federal, state, and local] laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern except with specific approval and acceptance by the Contracting Officer Representative.

### **1.4 ACCIDENT PREVENTION PLAN (APP):**

- A. The APP (aka Construction Safety & Health Plan) shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and ensure it is site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all worksite safety and health of each subcontractor(s). Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.
- B. The APP shall be prepared as follows:
1. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards pertaining to the contract (model language can be found in ASSE A10.33). Specifically articulating the safety requirements found within these VA contract safety specifications.
  2. Address both the Prime Contractors and the subcontractors work operations.

3. State measures to be taken to control hazards associated with materials, services, or equipment provided by suppliers.
4. Address all the elements/sub-elements and in order as follows:
  - a. **SIGNATURE SHEET.** Title, signature, and phone number of the following:
    - 1) Plan preparer (Qualified Person such as corporate safety staff person or contracted Certified Safety Professional with construction safety experience);
    - 2) Plan approver (company/corporate officers authorized to obligate the company);
    - 3) Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional). Provide concurrence of other applicable corporate and project personnel (Contractor).
  - b. **BACKGROUND INFORMATION.** List the following:
    - 1) Contractor;
    - 2) Contract number;
    - 3) Project name;
    - 4) Brief project description, description of work to be performed, and location; phases of work anticipated (these will require an AHA).
  - c. **STATEMENT OF SAFETY AND HEALTH POLICY.** Provide a copy of current corporate/company Safety and Health Policy Statement, detailing commitment to providing a safe and healthful workplace for all employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided.
  - d. **RESPONSIBILITIES AND LINES OF AUTHORITIES.** Provide the following:

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

etc...) and any requirements for periodic retraining/recertification are required.

- 3) Procedures for ongoing safety and health training for supervisors and employees shall be established to address changes in site hazards/conditions.
- 4) OSHA 10-hour training is required for all workers on site and the OSHA 30-hour training is required for Trade Competent Persons (CPs)

**g. SAFETY AND HEALTH INSPECTIONS.**

- 1) Specific assignment of responsibilities for a minimum daily job site safety and health inspection during periods of work activity: Who will conduct (e.g., "Site Safety and Health CP"), proof of inspector's training/qualifications, when inspections will be conducted, procedures for documentation, deficiency tracking system, and follow-up procedures.
- 2) Any external inspections/certifications that may be required (e.g., contracted CSP or CSHT)

**h. ACCIDENT INVESTIGATION & REPORTING.** The Contractor shall conduct mishap investigations of all OSHA Recordable Incidents. The APP shall include accident/incident investigation procedure & identify person(s) responsible to provide the following to the Contracting Officer Representative:

- 1) Exposure data (man-hours worked);
- 2) Accident investigations, reports, and logs.

**i. PLANS (PROGRAMS, PROCEDURES) REQUIRED.** Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational risks in site-specific compliance and accident prevention plans. These Plans shall include but are not be limited to procedures for addressing the risks associates with the following:

- 1) Emergency response ;
- 2) Contingency for severe weather;
- 3) Fire Prevention ;
- 4) Medical Support;
- 5) Posting of emergency telephone numbers;
- 6) Prevention of alcohol and drug abuse;
- 7) Site sanitation (housekeeping, drinking water, toilets);
- 8) Night operations and lighting ;
- 9) Hazard communication program;
- 10) Welding/Cutting "Hot" work ;
- 11) Electrical Safe Work Practices (Electrical LOTO/NFPA 70E);
- 12) General Electrical Safety
- 13) Hazardous energy control (Machine LOTO);
- 14) Site-Specific Fall Protection & Prevention;
- 15) Excavation/trenching;
- 16) Asbestos abatement;
- 17) Lead abatement;
- 18) Crane Critical lift;
- 19) Respiratory protection;
- 20) Health hazard control program;
- 21) Radiation Safety Program;
- 22) Abrasive blasting;
- 23) Heat/Cold Stress Monitoring;
- 24) Crystalline Silica Monitoring (Assessment);
- 25) Demolition plan (to include engineering survey);

26) Formwork and shoring erection and removal;

27) PreCast Concrete.

- C. Submit the APP to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.
- D. Once accepted by the Contracting Officer Representative, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.
- E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer Representative. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34) and the environment.

#### **1.5 ACTIVITY HAZARD ANALYSES (AHAS):**

- A. AHAs are also known as Job Hazard Analyses, Job Safety Analyses, and Activity Safety Analyses. Before beginning each work activity involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or sub-contractor is to perform the work, the Contractor(s) performing that work activity shall prepare an AHA (Example electronic AHA forms can be found on the US Army Corps of Engineers web site)
- B. AHAs shall define the activities being performed and identify the work sequences, the specific anticipated hazards, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk.

- C. Work shall not begin until the AHA for the work activity has been accepted by the Contracting Officer Representative and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as specified by OSHA and/or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.
  2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).
    - a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.
    - b. If a new Competent/Qualified Person (not on the original list) is added, the list shall be updated (an administrative action not requiring an updated AHA). The new person shall acknowledge in writing that he or she has reviewed the AHA and is familiar with current site safety issues.
  3. Submit AHAs to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

4. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.
5. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. All activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier, or subcontractor and provided to the prime contractor for review and approval and then submitted to the Contracting Officer Representative.

**1.6 PRECONSTRUCTION CONFERENCE:**

- A. Contractor representatives who have a responsibility or significant role in implementation of the accident prevention program, as required by 29 CFR 1926.20(b)(1), on the project shall attend the preconstruction conference to gain a mutual understanding of its implementation. This includes the project superintendent, subcontractor superintendents, and any other assigned safety and health professionals.
- B. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.
- C. Deficiencies in the submitted APP will be brought to the attention of the Contractor within 14 days of submittal, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

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

- A. The Prime Contractor shall designate a minimum of one SSHO at each project site that will be identified as the SSHO to administer the Contractor's safety program and government-accepted Accident Prevention



Plan. Each subcontractor shall designate a minimum of one CP in compliance with 29 CFR 1926.20 (b)(2) that will be identified as a CP to administer their individual safety programs.

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

#### **1.8 TRAINING:**

- A. The designated Prime Contractor SSHO must meet the requirements of all applicable OSHA standards and be capable (through training, experience, and qualifications) of ensuring that the requirements of 29 CFR 1926.16 and other appropriate Federal, State and local requirements are met for the project. As a minimum the SSHO must have completed the OSHA 30-hour Construction Safety class and have five (5) years of construction

industry safety experience or three (3) years if he/she possesses a Certified Safety Professional (CSP) or certified Construction Safety and Health Technician (CSHT) certification or have a safety and health degree from an accredited university or college.

- B. All designated CPs shall have completed the OSHA 30-hour Construction Safety course within the past 5 years.
- C. In addition to the OSHA 30 Hour Construction Safety Course, all CPs with high hazard work operations such as operations involving asbestos, electrical, cranes, demolition, work at heights/fall protection, fire safety/life safety, ladder, rigging, scaffolds, and trenches/excavations shall have a specialized formal course in the hazard recognition & control associated with those high hazard work operations. Documented "repeat" deficiencies in the execution of safety requirements will require retaking the requisite formal course.
- D. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course and any necessary safety training to be able to identify hazards within their work environment.
- E. Submit training records associated with the above training requirements to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance.
- F. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the SSHO or his/her designated representative. As a minimum, this briefing shall include information on the site-specific hazards, construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, emergency procedures, accident reporting etc... Documentation shall be provided to the Contracting Officer Representative that individuals have undergone contractor's safety briefing.
- G. Ongoing safety training will be accomplished in the form of weekly documented safety meeting.

#### **1.9 INSPECTIONS:**

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

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

- A. Notify the Contracting Officer Representative as soon as practical, but no more than four hours after any accident meeting the definition of OSHA Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$5,000, or any weight handling equipment accident. Within notification include contractor name;

contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Contracting Officer Representative determine whether a government investigation will be conducted.

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

#### **1.11 PERSONAL PROTECTIVE EQUIPMENT (PPE):**

- A. PPE is governed in all areas by the nature of the work the employee is performing. For example, specific PPE required for performing work on electrical equipment is identified in NFPA 70E, Standard for Electrical Safety in the Workplace.
- B. Mandatory PPE includes:
  - 1. Hard Hats - unless written authorization is given by the Contracting Officer Representative in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the

requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA regulations.

2. Safety glasses - unless written authorization is given by the Contracting Officer Representative appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.
3. Appropriate Safety Shoes - based on the hazards present, safety shoes meeting the requirements of ASTM F2413-11 shall be worn by each person on site unless written authorization is given by the Contracting Officer Representative.
4. Hearing protection - Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks.

#### **1.12 INFECTION CONTROL**

- A. Infection Control is critical in all medical center facilities. Interior construction activities causing disturbance of existing dust, or creating new dust, must be conducted within ventilation-controlled areas that minimize the flow of airborne particles into patient areas. Exterior construction activities causing disturbance of soil or creates dust in some other manner must be controlled.
- B. An AHA associated with infection control will be performed by VA personnel in accordance with FGI Guidelines (i.e. Infection Control Risk Assessment (ICRA)). The ICRA procedure found on the American Society for Healthcare Engineering (ASHE) website will be utilized. Risk classifications of Class II or lower will require approval by the Contracting Officer Representative before beginning any construction work. Risk classifications of Class III or higher will require a permit before beginning any construction work. Infection Control permits will be issued by the Contracting Officer Representative. The Infection Control Permits will be posted outside the appropriate construction area. More than one permit may be issued for a construction project if the work is located in separate areas requiring

separate classes. The primary project scope area for this project is:  
**Class I**, however, work outside the primary project scope area may vary.  
The required infection control precautions with each class are as follows:

1. Class I requirements:

a. During Construction Work:

- 1) Notify the Contracting Officer Representative.
- 2) Execute work by methods to minimize raising dust from construction operations.
- 3) Ceiling tiles: Immediately replace a ceiling tiles displaced for visual inspection.

b. Upon Completion:

- 1) Clean work area upon completion of task
- 2) Notify the Contracting Officer Representative

2. Class II requirements:

a. During Construction Work:

- 1) Notify the Contracting Officer Representative
- 2) Provide active means to prevent airborne dust from dispersing into atmosphere such as wet methods or tool mounted dust collectors where possible.
- 3) Water mist work surfaces to control dust while cutting.
- 4) Seal unused doors with duct tape.
- 5) Block off and seal air vents.
- 6) Remove or isolate HVAC system in areas where work is being performed.

b. Upon Completion:

- 1) Wipe work surfaces with cleaner/disinfectant.

- 2) Contain construction waste before transport in tightly covered containers.
- 3) Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.
- 4) Upon completion, restore HVAC system where work was performed
- 5) Notify the Contracting Officer Representative.

3. Class III requirements:

a. During Construction Work:

- 1) Obtain permit from the Contracting Officer Representative
- 2) Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system.
- 3) Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
- 4) Maintain negative air pressure, 0.01 inches of water gauge, within work site utilizing HEPA equipped air filtration units and continuously monitored with a digital display, recording and alarm instrument, which must be calibrated on installation, maintained with periodic calibration and monitored by the contractor.
- 5) Contain construction waste before transport in tightly covered containers.
- 6) Cover transport receptacles or carts. Tape covering unless solid lid.

b. Upon Completion:

- 1) Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative and

thoroughly cleaned by the VA Environmental Services Department.

- 2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
- 3) Vacuum work area with HEPA filtered vacuums.
- 4) Wet mop area with cleaner/disinfectant.
- 5) Upon completion, restore HVAC system where work was performed.
- 6) Return permit to the Contracting Officer Representative

4. Class IV requirements:

a. During Construction Work:

- 1) Obtain permit from the Contracting Officer Representative
- 2) Isolate HVAC system in area where work is being done to prevent contamination of duct system.
- 3) Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
- 4) Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
- 5) Seal holes, pipes, conduits, and punctures.
- 6) Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site.



- 7) All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.

b. Upon Completion:

- 1) Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative with thorough cleaning by the VA Environmental Services Dept.
- 2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
- 3) Contain construction waste before transport in tightly covered containers.
- 4) Cover transport receptacles or carts. Tape covering unless solid lid.
- 5) Vacuum work area with HEPA filtered vacuums.
- 6) Wet mop area with cleaner/disinfectant.
- 7) Upon completion, restore HVAC system where work was performed.
- 8) Return permit to the Contracting Officer Representative

C. Barriers shall be erected as required based upon classification (Class III & IV requires barriers) and shall be constructed as follows:

1. Class III and IV - closed door with masking tape applied over the frame and door is acceptable for projects that can be contained in a single room.
2. Construction, demolition or reconstruction not capable of containment within a single room must have the following barriers erected and made presentable on hospital occupied side:
  - a. Class III & IV (where dust control is the only hazard, and an agreement is reached with the Contracting Officer Representative and Medical Center) - Airtight plastic barrier that

extends from the floor to ceiling. Seams must be sealed with duct tape to prevent dust and debris from escaping

- b. Class III & IV - Drywall barrier erected with joints covered or sealed to prevent dust and debris from escaping.
- c. Class III & IV - Seal all penetrations in existing barrier airtight
- d. Class III & IV - Barriers at penetration of ceiling envelopes, chases and ceiling spaces to stop movement air and debris
- e. Class IV only - Anteroom or double entrance openings that allow workers to remove protective clothing or vacuum off existing clothing
- f. Class III & IV - At elevators shafts or stairways within the field of construction, overlapping flap minimum of two feet wide of polyethylene enclosures for personnel access.

D. Products and Materials:

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

6. Adhesive Walk-off Mats: Provide minimum size mats of 24 inches x 36 inches
  7. Disinfectant: Hospital-approved disinfectant or equivalent product
  8. Portable Ceiling Access Module
- E. Before any construction on site begins, all contractor personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.
- F. A dust control program will be establish and maintained as part of the contractor's infection preventive measures in accordance with the FGI Guidelines for Design and Construction of Healthcare Facilities. Prior to start of work, prepare a plan detailing project-specific dust protection measures with associated product data, including periodic status reports, and submit to Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- G. Medical center Infection Control personnel will monitor for airborne disease (e.g. aspergillosis) during construction. A baseline of conditions will be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality with safe thresholds established.
- H. In general, the following preventive measures shall be adopted during construction to keep down dust and prevent mold.
1. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. HEPA filtration is required where the exhaust dust may reenter the medical center.
  2. Exhaust hoses shall be exhausted so that dust is not reintroduced to the medical center.
  3. Adhesive Walk-off/Carpet Walk-off Mats shall be used at all interior transitions from the construction area to occupied medical center

area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.

4. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as it is created. Transport these outside the construction area in containers with tightly fitting lids.
5. The contractor shall not haul debris through patient-care areas without prior approval of the Contracting Officer Representative 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.
6. 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.
7. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.

I. Final Cleanup:

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

J. Exterior Construction

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

**1.13 TUBERCULOSIS SCREENING**

- A. Contractor shall provide written certification that all contract employees assigned to the work site have had a pre-placement tuberculin screening within 90 days prior to assignment to the worksite and been found have negative TB screening reactions. Contractors shall be required to show documentation of negative TB screening reactions for any additional workers who are added after the 90-day requirement before they will be allowed to work on the work site. NOTE: This can be the Center for Disease Control (CDC) and Prevention and two-step skin testing or a Food and Drug Administration (FDA)-approved blood test.
1. Contract employees manifesting positive screening reactions to the tuberculin shall be examined according to current CDC guidelines prior to working on VHA property.
  2. Subsequently, if the employee is found without evidence of active (infectious) pulmonary TB, a statement documenting examination by a physician shall be on file with the employer (construction contractor), noting that the employee with a positive tuberculin screening test is without evidence of active (infectious) pulmonary TB.

3. If the employee is found with evidence of active (infectious) pulmonary TB, the employee shall require treatment with a subsequent statement to the fact on file with the employer before being allowed to return to work on VHA property.

#### **1.14 FIRE SAFETY**

- A. Fire Safety Plan: Establish and maintain a site-specific fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. This plan may be an element of the Accident Prevention Plan.
- B. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- C. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- D. Temporary Construction Partitions:
  1. Install and maintain temporary construction partitions to provide smoke-tight separations between construction areas and adjoining areas. Construct partitions of gypsum board or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of fire retardant treated wood or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
  2. Install one-hour temporary construction partitions as shown on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.

3. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.
- E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with Contracting Officer Representative.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Contracting Officer Representative.
- H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- J. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with Contracting Officer Representative. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the Resident Engineer.
- K. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Contracting Officer Representative.

- L. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Contracting Officer Representative. Obtain permits from Contracting Officer Representative at least 72 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- M. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Contracting Officer Representative.
- N. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- O. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- P. If required, submit documentation to the Contracting Officer Representative that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

#### **1.15 ELECTRICAL**

- A. All electrical work shall comply with NFPA 70 (NEC), NFPA 70B, NFPA 70E, 29 CFR Part 1910 Subpart J - General Environmental Controls, 29 CFR Part 1910 Subpart S - Electrical, and 29 CFR 1926 Subpart K in addition to other references required by contract.
- B. All qualified persons performing electrical work under this contract shall be licensed journeyman or master electricians. All apprentice electricians performing under this contract shall be deemed unqualified persons unless they are working under the immediate supervision of a licensed electrician or master electrician.
- C. All electrical work will be accomplished de-energized and in the Electrically Safe Work Condition ( refer to NFPA 70E for Work Involving Electrical Hazards, including Exemptions to Work Permit). Any Contractor, subcontractor or temporary worker who fails to fully comply



with this requirement is subject to immediate termination in accordance with FAR clause 52.236-5(c). Only in rare circumstance where achieving an electrically safe work condition prior to beginning work would increase or cause additional hazards, or is infeasible due to equipment design or operational limitations is energized work permitted. The Contracting Officer Representative with approval of the Medical Center Director will make the determination if the circumstances would meet the exception outlined above. An AHA specific to energized work activities will be developed, reviewed, and accepted prior to the start of that work.

1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.
  2. Verification of the absence of voltage after de-energization and lockout/tagout is considered "energized electrical work" (live work) under NFPA 70E, and shall only be performed by qualified persons wearing appropriate shock protective (voltage rated) gloves and arc rate personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.
  3. Personal Protective Equipment (PPE) and electrical testing instruments will be readily available for inspection by the The Contracting Officer Representative.
- D.** Before beginning any electrical work, an Activity Hazard Analysis (AHA) will be conducted to include Shock Hazard and Arc Flash Hazard analyses (NFPA Tables can be used only as a last alternative and it is strongly suggested a full Arc Flash Hazard Analyses be conducted). Work shall not begin until the AHA for the work activity has been accepted by the Contracting Officer Representative and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and

Government on-site representatives at preparatory and initial control phase meetings.

- E. Ground-fault circuit interrupters. All 120-volt, single-phase 15- and 20-ampere receptacle outlets on construction sites shall have approved ground-fault circuit interrupters for personnel protection. "Assured Equipment Grounding Conductor Program" only is not allowed.

#### **1.16 FALL PROTECTION**

- A. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) for ALL WORK, unless specified differently or the OSHA 29 CFR 1926 requirements are more stringent, to include steel erection activities, systems-engineered activities (prefabricated) metal buildings, residential (wood) construction and scaffolding work.
  - 1. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.
  - 2. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.
  - 3. A Warning Line System (WLS) may ONLY be used on floors or flat or low-sloped roofs (between 0 - 18.4 degrees or 4:12 slope) and shall be erected around all sides of the work area (See 29 CFR 1926.502(f) for construction of WLS requirements). Working within the WLS does not require FP. No worker shall be allowed in the area between the roof or floor edge and the WLS without FP. FP is required when working outside the WLS.
  - 4. Fall protection while using a ladder will be governed by the OSHA requirements.

#### **1.17 SCAFFOLDS AND OTHER WORK PLATFORMS**

- A. All scaffolds and other work platforms construction activities shall comply with 29 CFR 1926 Subpart L.
- B. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) as stated in Section 1.16.

C. The following hierarchy and prohibitions shall be followed in selecting appropriate work platforms.

1. Scaffolds, platforms, or temporary floors shall be provided for all work except that can be performed safely from the ground or similar footing.
2. Ladders less than 20 feet may be used as work platforms only when use of small hand tools or handling of light material is involved.
3. Ladder jacks, lean-to, and prop-scaffolds are prohibited.
4. Emergency descent devices shall not be used as working platforms.

D. Contractors shall use a scaffold tagging system in which all scaffolds are tagged by the Competent Person. Tags shall be color-coded: green indicates the scaffold has been inspected and is safe to use; red indicates the scaffold is unsafe to use. Tags shall be readily visible, made of materials that will withstand the environment in which they are used, be legible and shall include:

1. The Competent Person's name and signature;
2. Dates of initial and last inspections.

E. Mast Climbing work platforms: When access ladders, including masts designed as ladders, exceed 20 ft (6 m) in height, positive fall protection shall be used.

#### **1.18 EXCAVATION AND TRENCHES**

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

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

#### **1.19 CRANES**

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

- b. or overhead protection with a design live load of 300 psf is provided

#### **1.20 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)**

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

#### **1.21 CONFINED SPACE ENTRY**

- A. All confined space entry shall comply with 29 CFR 1910.146 except for specifically referenced operations in 29 CFR 1926 such as excavations/trenches [1926.651(g)].
- B. A site-specific Confined Space Entry Plan (including permitting process) shall be developed and submitted to the Contracting Officer Representative.

#### **1.22 WELDING AND CUTTING**

As specified in section 1.14, Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Contracting Officer Representative. Obtain permits from Contracting Officer Representative at least 72 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

#### **1.23 LADDERS**

- A. All Ladder use shall comply with 29 CFR 1926 Subpart X.
- B. All portable ladders shall be of sufficient length and shall be placed so that workers will not stretch or assume a hazardous position.
- C. Manufacturer safety labels shall be in place on ladders

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

#### **1.24 FLOOR & WALL OPENINGS**

- A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M.
- B. Floor and roof holes/openings are any that measure over 2 in (51 mm) in any direction of a walking/working surface which persons may trip or fall into or where objects may fall to the level below. See 21.F for covering and labeling requirements. Skylights located in floors or roofs are considered floor or roof hole/openings.
- C. All floor, roof openings or hole into which a person can accidentally walk or fall through shall be guarded either by a railing system with toeboards along all exposed sides or a load-bearing cover. When the cover is not in place, the opening or hole shall be protected by a removable guardrail system or shall be attended when the guarding system has been removed, or other fall protection system.
  - 1. Covers shall be capable of supporting, without failure, at least twice the weight of the worker, equipment and material combined.

2. Covers shall be secured when installed, clearly marked with the word "HOLE", "COVER" or "Danger, Roof Opening-Do Not Remove" or color-coded or equivalent methods (e.g., red or orange "X"). Workers must be made aware of the meaning for color coding and equivalent methods.
3. Roofing material, such as roofing membrane, insulation or felts, covering or partly covering openings or holes, shall be immediately cut out. No hole or opening shall be left unattended unless covered.
4. Non-load-bearing skylights shall be guarded by a load-bearing skylight screen, cover, or railing system along all exposed sides.
5. Workers are prohibited from standing/walking on skylights.

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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 the 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):
  - T27-11.....Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
  - T96-02 (R2006).....Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
  - T99-10.....Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
  - T104-99 (R2007).....Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
  - T180-10.....Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
  - T191-02(R2006).....Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method
- C. American Concrete Institute (ACI):
  - 506.4R-94 (R2004).....Guide for the Evaluation of Shotcrete
- D. American Society for Testing and Materials (ASTM):
  - A325-10.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
  - A370-12.....Standard Test Methods and Definitions for Mechanical Testing of Steel Products

A416/A416M-10.....Standard Specification for Steel Strand,  
Uncoated Seven-Wire for Prestressed Concrete  
A490-12.....Standard Specification for Heat Treated Steel  
Structural Bolts, 150 ksi Minimum Tensile  
Strength  
C31/C31M-10.....Standard Practice for Making and Curing Concrete  
Test Specimens in the Field  
C33/C33M-11a.....Standard Specification for Concrete Aggregates  
C39/C39M-12.....Standard Test Method for Compressive Strength of  
Cylindrical Concrete Specimens  
C109/C109M-11b.....Standard Test Method for Compressive Strength of  
Hydraulic Cement Mortars  
C136-06.....Standard Test Method for Sieve Analysis of Fine  
and Coarse Aggregates  
C138/C138M-10b.....Standard Test Method for Density (Unit Weight),  
Yield, and Air Content (Gravimetric) of Concrete  
C140-12.....Standard Test Methods for Sampling and Testing  
Concrete Masonry Units and Related Units  
C143/C143M-10a.....Standard Test Method for Slump of Hydraulic  
Cement Concrete  
C172/C172M-10.....Standard Practice for Sampling Freshly Mixed  
Concrete  
C173/C173M-10b.....Standard Test Method for Air Content of freshly  
Mixed Concrete by the Volumetric Method  
C330/C330M-09.....Standard Specification for Lightweight  
Aggregates for Structural Concrete  
C567/C567M-11.....Standard Test Method for Density Structural  
Lightweight Concrete  
C780-11.....Standard Test Method for Pre-construction and  
Construction Evaluation of Mortars for Plain and  
Reinforced Unit Masonry  
C1019-11.....Standard Test Method for Sampling and Testing  
Grout  
C1064/C1064M-11.....Standard Test Method for Temperature of Freshly  
Mixed Portland Cement Concrete  
C1077-11c.....Standard Practice for Agencies Testing Concrete  
and Concrete Aggregates for Use in Construction  
and Criteria for Testing Agency Evaluation  
C1314-11a.....Standard Test Method for Compressive Strength of  
Masonry Prisms

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

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

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

D1143/D1143M-07e1.....Standard Test Methods for Deep Foundations Under  
Static Axial Compressive Load

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

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

D1557-09.....Standard Test Methods for Laboratory Compaction  
Characteristics of Soil Using Modified Effort  
(56,000ft lbf/ft<sup>3</sup> (2,700 KNm/m<sup>3</sup>))

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

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

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

D2974-07a.....Standard Test Methods for Moisture, Ash, and  
Organic Matter of Peat and Other Organic Soils

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

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

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

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

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

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

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

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

E1155-96(R2008).....Determining FF Floor Flatness and FL Floor  
Levelness Numbers

E. American Welding Society (AWS):

D1.D1.1M-10.....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.; E329, C1077, D3666, D3740, A880, E543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by Contracting Officer Representative. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of Contracting Officer Representative to such failure.
- C. Written Reports: Testing laboratory shall submit test reports directly to Contracting Officer Representative, Contractor, unless other arrangements are agreed to in writing by the Contracting Officer Representative. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to Contracting Officer Representative 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 Contracting Officer Representative regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to Contracting Officer Representative extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
  2. Provide full time observation of fill placement and compaction and field density testing in 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.
  2. Make field density tests in accordance with the primary testing method following ASTM D6938 wherever possible. Field density tests utilizing ASTM D1556, 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 Contracting Officer Representative before the tests are conducted.
- c. Pavement Subgrade: One test for each 335 m<sup>2</sup> (400 square yards), but in no case fewer than two tests.
  - d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
  - e. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (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 Contracting Officer Representative. In each compacted fill layer below wall footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.
- C. Fill and Backfill Material Gradation: One test per 50 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C136.
- D. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.
- E. Testing Materials: Test suitability of on-site and off-site borrow as directed by Contracting Officer Representative.

#### **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 Contracting Officer Representative.

#### **3.5 ASPHALT CONCRETE PAVING:**

- A. Aggregate Base Course:
  - 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with ASTM D1557, Method D.
  - 2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556.
  - 3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.
- B. Asphalt Concrete:
  - 1. Aggregate: Sample and test aggregates in stock pile and hot-bins as necessary to insure compliance with specification requirements for

- gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104).
2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.
  3. Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

### **3.6 SITE WORK CONCRETE:**

Test site work concrete including materials for concrete as required in Article Concrete of this Section.

### **3.8 CONCRETE:**

#### **A. Batch Plant Inspection and Materials Testing:**

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

#### **B. Field Inspection and Materials Testing:**

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

- is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m<sup>3</sup> (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 Contracting Officer Representative make three cylinders for each 80 m<sup>3</sup> (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. Contracting Officer Representative 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 80 m<sup>3</sup> (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
  6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
  7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
  8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
  9. Verify that specified mixing has been accomplished.
  10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
    - a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour



- period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
- b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. Observe preparations for placement of concrete:
- a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
- b. Inspect preparation of construction, expansion, and isolation joints.
16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
- a. Monitor and record amount of water added at project site.
- b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
- a. Perform Floor Tolerance Measurements  $F_F$  and  $F_L$  in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
- b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
- c. Provide the Contractor and the Contracting Officer Representative 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 Contracting Officer Representative. 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 Contracting Officer Representative. 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 MPa (psi).
  - e. Weight of lightweight structural concrete in kg/m<sup>3</sup> (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. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.
- C. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.
- D. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

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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 affect 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 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 Contracting Officer's Representative 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 Contracting Officer's Representative. Do not fasten or attach ropes,

cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.

1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.
2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
  - a. Box and protect from damage existing trees and shrubs to remain on the construction site.
  - b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
  - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.
  - a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of a local ten design year) storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, draining from the surface.
  - b. Reuse or conserve the collected topsoil sediment as directed by the Contracting Officer's Representative. Topsoil use and requirements are specified in Section 31 20 00, EARTH MOVING.
  - c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.

5. Erosion and Sedimentation Control Devices: The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and permanent erosion and sedimentation control features. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.
  6. Manage borrow areas on Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.
  7. Manage and control spoil areas.
  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 Contracting Officer's Representative.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
  2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
  3. Monitor water areas affected by construction.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference

with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list species that require specific attention along with measures for their protection.

- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of California and State Air Pollution Statute, Rule, or Regulation and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
  2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
  3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
  4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- 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 Contracting Officer's Representative. 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 Contracting Officer's Representative. 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

- 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 Contracting Officer's Representative. 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.

**PART 2 - PRODUCTS**

Not Used

**PART 3 - EXECUTION**

Not Used

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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. All Sections listed in the Table of Contents are a Condition of this Section.

## **1.3 QUALITY ASSURANCE**

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

- F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.
- G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.
- H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

#### **1.4 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 Representative 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.

## **1.7 RECORDS**

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

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

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

## **PART 3 - EXECUTION**

### **3.1 COLLECTION**

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

### **3.2 DISPOSAL**

- A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.



- B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

### **3.3 REPORT**

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

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

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies demolition and removal of buildings, portions of buildings, utilities, portion of utility access structures, pavements, curbs and gutters, landscaping, signage, light and light poles, other structures and debris from trash dumps shown.

**1.2 RELATED WORK:**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**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.
  3. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
  4. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
  5. Reestablish electrical power to facilities and fixtures that are served from areas of demolition.
- 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 Representative. 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 Contracting Officer Representative's approval.
- H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- I. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.

**1.4 UTILITY SERVICES:**

- A. Demolish and remove outside utility service lines shown to be removed.
- B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

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

**PART 3 - EXECUTION**

**3.1 DEMOLITION:**

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

located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.

- E. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer Representative. When Utility lines are encountered that are not indicated on the drawings, the Contracting Officer Representative shall be notified prior to further work in that area.

### **3.2 CLEAN-UP:**

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to Contracting Officer Representative. 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 03 30 00**  
**CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Provide labor, material, equipment and services to furnish and install cast-in-place concrete as shown on the drawings, as specified herein and as required for a complete and proper installation, including, but not limited to, the following:
1. Concrete curbs and gutters
  2. Concrete walks and ramps
  3. Site Foundations

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 TOLERANCES**

- A. Slab Finishes: ACI 117, 10 foot (3000 mm) straightedge method.

**1.4 REGULATORY REQUIREMENTS**

- A. ACI 315 - Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.

**1.5 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Concrete Mix Design.
- C. Shop Drawings: Reinforcing steel: Complete shop drawings.
- D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.
- E. Job Site Finish Samples: 5' x 5' x 4".

**1.6 APPLICABLE STANDARDS**

- 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-90.....Standard Tolerances for Concrete Construction and Materials
- 301-89.....Specification for Structural Concrete for Buildings

- 305R-91.....Hot Weather Concreting
- 306R-88.....Cold Weather Concreting
- 315-80(92).....Details and Detailing of Concrete Reinforcement
- 318/318R-95.....Building Code Requirements for Reinforced Concrete
- 347R-94.....Guide to Formwork for Concrete
- C. American Society for Testing and Materials (ASTM):
  - A185-94.....Steel Welded Wire, Fabric, Plain for Concrete Reinforcement
  - A615/A615M-95.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - A616/A616M-95.....Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
  - C31-91.....Making and Curing Concrete Test Specimens in the Field
  - C33-93.....Concrete Aggregates
  - C39-94.....Compressive Strength of Cylindrical Concrete Specimens
  - C94-94.....Ready-Mixed Concrete
  - C143-90, Rev A.....Slump of Portland Cement Concrete
  - C150-95.....Portland Cement
  - C171-95.....Sheet Material for Curing Concrete
  - C172-90.....Sampling Freshly Mixed Concrete
  - C173-94(E1-95).Air Content of Freshly Mixed Concrete by the Volumetric Method
  - C192-90.....Making and Curing Concrete Test Specimens in the Laboratory
  - C231-91.....Air Content of Freshly Mixed Concrete by the Pressure Method
  - C260-95.....Air-Entraining Admixtures for Concrete
  - C494-92.....Chemical Admixtures for Concrete
  - D1751-83 (R-1)....Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
  - D4397-91.....Polyethylene Sheeting for Construction, Industrial and Agricultural Applications



**1.7 TESTING AGENCY FOR CONCRETE MIX DESIGN:**

- A. Testing agency retained and reimbursed by the Contractor and approved by Contracting Officer's Representative.
- B. Testing agency maintaining active participation in Program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology.
- C. Testing agency shall furnish equipment and qualified technicians to establish proportions of ingredients for concrete mixes.

**PART 2 - PRODUCTS**

**2.1 FORMS**

- A. Wood, plywood, metal, or other materials, approved by the Contracting Officer's Representative, of grade or type suitable to obtain type of finish specified.

**2.2 MATERIALS**

- A. Portland Cement: ASTM C150, Type II, same brand throughout.
- B. Coarse Aggregate: ASTM C33 Size 67. Size 467 may be used for footings and walls over 2 inches (1300 mm) thick. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.
- C. Fine Aggregate: ASTM C33.
- D. Mixing Water: Fresh, clean, and potable.
- E. Air-Entraining Admixture: ASTM C260.
- F. Chemical Admixtures: ASTM C494.
- G. Vapor Barrier: ASTM D4397, 6 mil (150 um).
- H. Reinforcing Steel: ASTM A615 or ASTM A616, deformed, Grade 60.
- I. Welded Wire Fabric: ASTM A185.
- J. Expansion Joint Filler: ASTM D1751.
- K. Sheet Materials for Curing Concrete: ASTM C171.
- L. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- M. 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.
- N. 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 5,000 psi (35mpa) at 3 days.

O. Architectural Concrete:

1. Pigments: Davis Colors, Scofield Chromix, Solomon Colors or approved equal. Obtain COR approval of mock up.
2. White Cement: ASTM C150, Type I, same brand throughout.
3. Selected Aggregates: chosen for light color.
4. No Flyash, mineral admixtures or pozzolans.

**2.3 CONCRETE MIXES**

A. Mix Designs: Proportioned in accordance with Section 5.3,

"Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.

1. If trial mixes are used, make a set of at least 6 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test three for compressive strength at 7 days and three at 28 days.
2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including cement, fly ash, admixtures, weight of fine and coarse aggregate per m<sup>3</sup> (cubic yard) measured dry rodded and damp loose, specific gravity, fineness modulus, percentage of moisture, air content, water to cement-fly ash ratio, and consistency of each cylinder in terms of slump. Include dry unit weight of lightweight structural concrete.
3. Prepare a curve showing relationship between water to cement-fly ash ratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
4. If the field experience method is used, submit complete standard deviation analysis.

B. After approval of mixes no substitution in material or change in proportions of approval mixes may be made without additional tests and approval of Contracting Officer's Representative or as specified. Making and testing of preliminary test cylinders may be carried on pending approval of cement and fly ash, providing Contractor and manufacturer certify that ingredients used in making test cylinders are the same. Contracting Officer's Representative may allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement and fly ash and approval of design mix.

C. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.

D. Compressive strength:

1. All: Compressive strength at 28 days shall be not less than 25 mpa (3000 psi).

E. Maximum slump for vibrated concrete is typically 4 inches tested in accordance with ASTM C143, except for retaining walls and grade beams maximum slump is 3 inches.

F. Cement and water factor:

1. Non-Air-Entrained

- a. Min. Cement 280 kg/m<sup>3</sup> (470 lbs./c. yd)
- b. Max. Water Cement Ratio 0.55.

2. Air-Entrained

- a. Min. Cement 290 kg/m<sup>3</sup> (490 lbs./c. yd)
- b. Max. Water Cement Ratio 0.45.

E. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, SIDEWALKS AND CURBS.

**2.4 BATCHING & MIXING**

- A. Ready-mixed concrete to 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.

**PART 3 - EXECUTION**

**3.1 FORMWORK**

- A. Installation conform to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.
- B. Treating and Wetting: Treat or wet contact forms as follows:
1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
  2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather cool metal forms by thoroughly wetting with water just before placing concrete.
  3. Use sealer on reused plywood forms as specified for new material.

- C. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.
- D. Construction Tolerances: 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.

### **3.2 REINFORCEMENT**

- A. General: Details of concrete reinforcement in accordance with ACI 318 and ACI 315, unless otherwise shown.
- B. Placing: Place reinforcement conforming to CRSI DA4, unless otherwise shown. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

### **3.3 PLACING CONCRETE**

- A. Remove water from excavations before concrete is deposited. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Provide screeds at required elevations for concrete slabs.
- B. Before depositing 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. Obtain approval of Contracting Officer's Representative before placing concrete.
- D. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water or cement more than 1 1/2 hours. Do not allow concrete to drop freely more than 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by 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 305 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 306, to prevent freezing of thin sections less than 12 inches (300 mm) and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from Contracting Officer's Representative.

### **3.4 PROTECTION AND CURING**

A. 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 Contracting Officer's Representative.

### **3.5 FORM REMOVAL**

A. 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**

A. Immediately after forms have been removed and work has been examined and approved by Contracting Officer's Representative, 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 Contracting Officer's Representative 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.

**3.9 RETAINING WALLS:**

- A. Use air-entrained concrete.
- B. Weep holes, reinforcement and railings installed and constructed as shown.
- C. Place porous backfill as shown.

**3.10 SIDEWALKS**

- A. Use air-entrained concrete.
- B. Expansion and contraction joints, reinforcement installed and constructed as shown.
- C. Place subbase as shown.
- D. Add Davis Colors "Pebble" #641 pigment and finish, to match existing adjacent sidewalks.

- - - E N D - - -

**SECTION 10 14 00**

**SIGNAGE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies exterior medical center identification signs, building identification signs, parking and traffic regulatory signs.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 MANUFACTURER'S QUALIFICATIONS**

Sign manufacturer shall provide evidence that they regularly and presently manufacture signs similar to those specified in this section as one of their principal products.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 00, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Manufacturer's Literature:
  - 1. Showing the methods and procedures proposed for the concealed anchorage of the signage system to each surface type.
  - 2. Manufacturer's printed specifications, anchorage details, installation and maintenance instructions.
- C. Shop Drawings:
  - 1. Sign location plan, showing location, type and total number of signs required.
  - 2. Scaled drawings for manufacture and fabrication of sign types. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes.
  - 3. Full size layouts of signs of the following signs:
    - a. Custom Regulatory.
- D. Samples:
  - 1. All sign colors.

**1.5 DELIVERY AND STORAGE**

- A. Deliver materials to job in manufacturer's original sealed containers with brand name marked thereon. Protect materials from damage.

- B. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.
- C. Deliver signs only when the site and mounting services are ready for installation work to proceed.
- D. Store products in dry condition inside enclosed facilities.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate
  - B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and tubes.
- C. Federal Specifications (Fed Spec):
  - MIL-PRF-8184F.....Plastic Sheet, Acrylic, Modified.
  - MIL-P-46144C.....Plastic Sheet, Polycarbonate

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. Signs of type, size and design shown on the drawings and as specified.
- B. Signs complete with lettering, framing and related components for a complete installation.
- C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.
- D. Do not scale drawings for dimensions. Contractor to verify and be responsible for all dimensions and conditions shown by these drawings. Contracting Officer's Representative to be notified of any discrepancy in drawing, in field directions or conditions, and/or of any changes required for all such construction details.
- E. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. The Contractor shall further warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.



## **2.2 PRODUCTS**

- A. General: For items exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names or roughness.
- B. Aluminum:
  - 1. Sheet and Plate: ASTM B209.
  - 2. Extrusions and Tubing: ASTM B221.
  - 3. Castings: ASTM B26.
- C. Concrete Post Footings: See Section 03 30 53, CAST-IN-PLACE CONCRETE.
- D. Steel:
  - 1. Posts: ASTM A53 Grade B, Schedule 40 pipe, Galvanized G90.
  - 2. Sheet: ASTM A1008, ASTM A591 electrolytic zinc coated.
- E. Stainless Steel:
  - 1. Sheet: ASTM A480.
  - 2. Posts: ASTM 6063.
  - 3. Billets: ASTM A314.

## **2.3 SIGN STANDARDS**

- A. Typography:
  - 1. Type Style: Helvetica Regular and Helvetica Bold. Initial caps or all caps as indicated in Sign Message Schedule.
  - 2. Arrow: See graphic standards in drawings.
  - 3. Letter spacing: See graphic standards on drawings.
  - 4. Letter spacing: See graphic standards on drawings.
  - 5. All text, arrows, and symbols to be provided in size, colors, typefaces and letter spacing shown. Text shall be a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings are for layout purposes only; final text for signs is listed in Sign Message Schedule.

## **2.4 SIGN TYPES**

- A. General:
  - 1. The exterior sign system is comprised of sign types families that are identified by a letter and number which identify a particular group of signs. An additional number identifies a specific type of sign within that family.
    - a. EI designation indicates exterior internally illuminated sign.
    - b. EN designation indicates exterior non-illuminated sign.
    - c. PL designation indicates parking control signs.

- d. IN designation indicates regulatory signs.
- 2. Sign Type Families 01, 02, etc.: Are to be as shown on the drawings.
- B. Cast Characters: Produce characters with smooth flat faces, sharp corners, precisely formed lines and profiles, free from pits, scale, sand holes and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs. Alloy and temper recommended by sign Manufacturer for casting process used and for use and finish indicated.
  - 1. Character Material: Aluminum
  - 2. Mounting: Concealed studs.
- C. Traffic Regulatory Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following minimum requirements:
  - 1. Steel Sheet: 0.0625 inch thick, painted.
- D. Exterior Policy Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following minimum requirements:
  - 1. Aluminum Sheet: 0.1250 inch thick, painted.
- E. Posts: As shown on the drawings.
  - 1. 3 inch square aluminum tubing, painted.
- F. Accessories:
  - 1. Anchors and inserts: Provide hot-dipped galvanized anchors and inserts for exterior installations. Use toothed steel devices for drilled in anchors. Furnish inserts to be set into concrete or masonry work. Furnish galvanized through bolts for attachment to posts.

## 2.5 FABRICATION

- A. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.
- B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
- C. Shop fabricate so far as practicable. Joints fastened flush to conceal reinforcement, or welded where thickness or section permits.

- D. Contact surfaces of connected members be true. Assembled so joints will be tight and practically unnoticeable, without use of filling compound.
- E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces be smooth flat and without oil-canning, free of rack and twist. Maximum variation from plane of surface plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.
- F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth surfaces.
- G. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.
- H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.
- I. Coat aluminum exterior signs with low VOC acrylic polyurethane. Paint coatings are to be UV and graffiti resistant and able to maintain a consistent color and durability.
- J. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.
- K. All signs are to be constructed in a manner where front faces are free of exposed fasteners.
- L. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.
- M. No signs are to be manufactured until final sign message schedule and location review has been completed by the Contracting Officer's Representative & forwarded to contractor.

## **2.6 FINISHES**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Baked Enamel: Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating and painting.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Protect products against damage during field handling and installation. Protect adjacent existing and newly placed construction, landscaping and finishes as necessary to prevent damage during installation. Paint and touch up any exposed fasteners and connecting hardware to match color and finish of surrounding surface.
- B. Mount signs in proper alignment, level and plumb according to the sign location plan and the dimensions given on elevation and sign location drawings. Where otherwise not dimensioned, signs shall be installed where best suited to provide a consistent appearance throughout the project. When exact position, angle, height or location is in doubt, contact Contracting Officer's Representative for clarification.
- C. Contractor shall be responsible for all signs that are damaged, lost or stolen while materials are on the job site and up until the completion and final acceptance of the job.
- D. Remove or correct signs or installation work Contracting Officer's Representative determines as unsafe or as an unsafe condition.
- E. At completion of sign installation, clean exposed sign surfaces. Clean and repair any adjoining surfaces and landscaping that became soiled or damaged as a result of installation of signs.
- F. Locate signs as shown on the Sign Location Plans.
- G. Contractor will be responsible for verifying that behind each sign location there are no utility lines that will be affected by installation of signs. Any damage during installation of signs to utilities will be the sole responsibility of the Contractor to correct and repair.
- H. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices which may involve other trades.
- I. Set aluminum posts in concrete as shown.
- J. Screw fence mounted signs to pickets with stainless steel #8 pan head screws.

#### **3.2 CLEANING AND PROTECTION**

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by the Contracting Officer's Representative.

#### **3.3 SIGN TYPES**

Included herein are selected pages from the "VAPAHCS Landscape Master Plan & Design Guidelines" 2013 and "VA Signage Design Guide" 2012:

## **Project Colors**

The Colors listed below are used throughout the VA Palo Alto Sign System. Refer to the sign types listed on the following pages for specific color applications.



**Color P1** - Blue  
Matthews MP01989



**Color P2** - Metallic Grey  
877 PMS  
Matthews MP18146



**Color P3** - White  
Matthews MP32071



**Color P4** - Red  
187 PMS  
Matthews MP10224



**Color P6** - ADA Blue  
294 PMS  
Matthews MP 03547



**Color V1** - Reflective White Vinyl  
3M 5100R-10 White



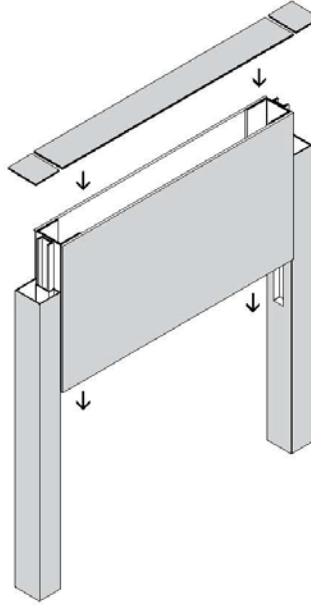
**Color V2** - Translucent Red Vinyl  
3M 3630-53 Cardinal Red

**Construction**

**Exterior Signs**

**Detail 19**

Basic aluminum post and panel sign.



## Construction

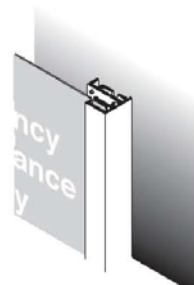
## Exterior Signs

### Detail 24

#### Non-Illuminated Wall Mounted Sign

This sign is constructed with an aluminum panel mounted into an extruded aluminum frame configured for wall mounting.

Sign face is held within a frame which will allow for replacement of the sign face without disassembly or abandonment of entire sign.

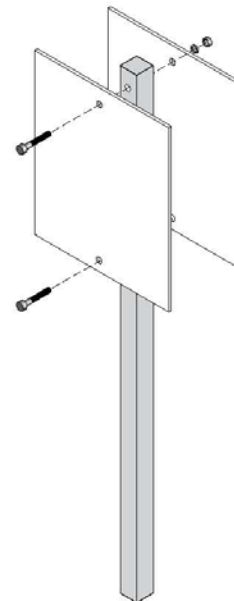
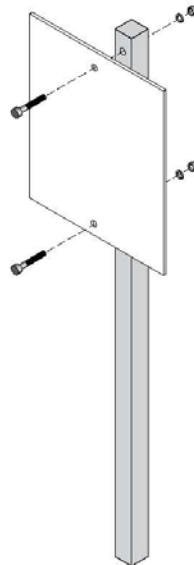


### Detail 25

#### Single Post & Panel Sign

Aluminum sign panel mounted to a square aluminum post with tamper proof mechanical fasteners.

Sign panels have the corners eased with a 6 mm (0.25") radius. The post shall have a permanent top cap.



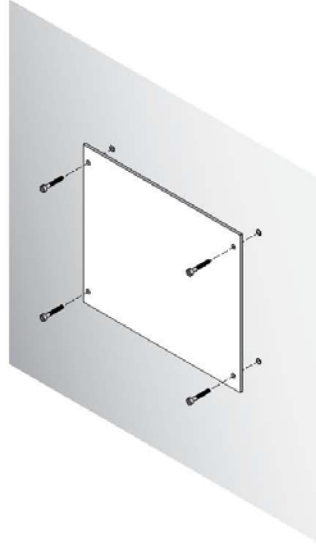
## Installation

## Exterior Signs

### Wall Mounting: Non-Illuminated Signs

Aluminum wall panel signs shall be fastened with a minimum of 2 mechanical fasteners.

anchors should be provided in the wall that are suitable for the particular type of wall surface where the sign is being installed.







**EN10.1 -**  
Stop  
(R1-1): 24", 30", 36"



**EN10.2 -**  
Do Not Enter  
(R5-1): 30", 36"



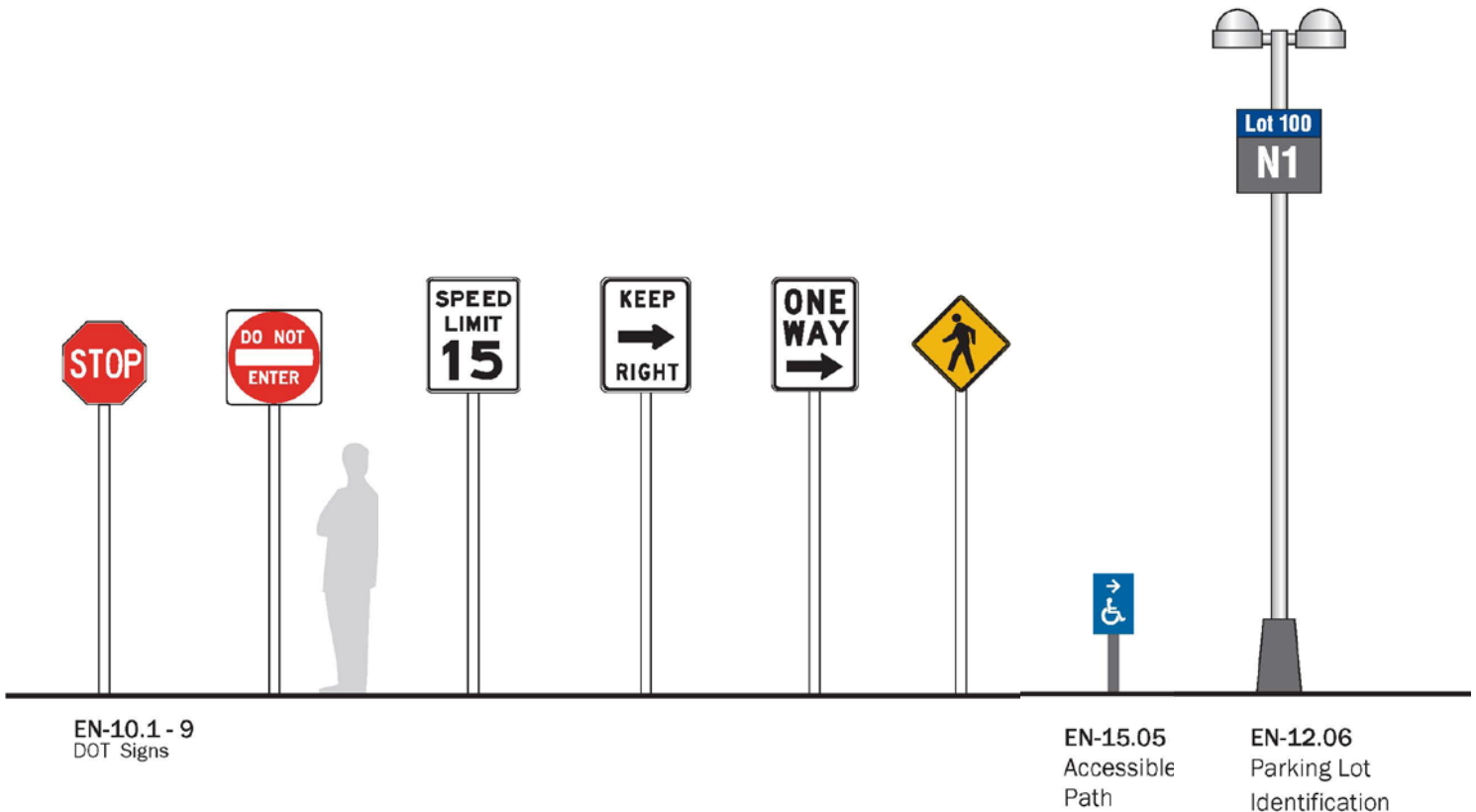
**EN10.4 -**  
Speed Limit  
(R2-8)



**EN10.6 -**  
One Way  
(R6-2L, R6-2R)



**EN10.9 -**  
Pedestrian Crossing



- - - END - - -



**SECTION 26 05 11**  
**REQUIREMENTS FOR ELECTRICAL INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, panelboards, and other items and arrangements for the specified items are shown on the drawings.
- C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.
- D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

**1.2 MINIMUM REQUIREMENTS**

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

**1.3 TEST STANDARDS**

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety

requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.

**B. Definitions:**

1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified: Materials and equipment which:
  - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
  - b. Are periodically inspected by a NRTL.
  - c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

**1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)**

A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.

**B. Product Qualification:**

1. Manufacturer's materials and equipment shall have been in

satisfactory operation, on three installations of similar size and type as this project, for at least three years.

2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

#### **1.5 APPLICABLE PUBLICATIONS**

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

#### **1.6 MANUFACTURED PRODUCTS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.
- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  1. Components of an assembled unit need not be products of the same manufacturer.
  2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  3. Components shall be compatible with each other and with the total assembly for the intended service.
  4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
  1. The Government shall have the option of witnessing factory tests.

- The Contractor shall notify the Government through the Contracting Officer Representative a minimum of 15 working days prior to the manufacturer's performing the factory tests.
2. Four copies of certified test reports shall be furnished to the Contracting Officer Representative two weeks prior to final inspection and not more than 90 days after completion of the tests.
  3. When materials and equipment fail factory tests, and re-testing and re-inspection is required, the Contractor shall be liable for all additional expenses for the Government to witness re-testing.

#### **1.7 VARIATIONS FROM CONTRACT REQUIREMENTS**

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

#### **1.8 MATERIALS AND EQUIPMENT PROTECTION**

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

#### **1.9 WORK PERFORMANCE**

- A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J - General

Environmental Controls, OSHA Part 1910 subpart K - Medical and First Aid, and OSHA Part 1910 subpart S - Electrical, in addition to other references required by contract.

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

#### **1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.

C. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

- D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.

**1.11 EQUIPMENT IDENTIFICATION**

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
- B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.
- C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches),



working distance (inches), arc flash incident energy at the working distance (calories/cm<sup>2</sup>), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

#### 1.12 SUBMITTALS

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

problems (e.g., vibration, thermal expansion, etc.) associated with equipment or piping so that the proposed installation can be properly reviewed. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and attached to the equipment.

3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
4. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.

F. Maintenance and Operation Manuals:

1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
  - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
  - b. A control sequence describing start-up, operation, and shutdown.
  - c. Description of the function of each principal item of equipment.
  - d. Installation instructions.
  - e. Safety precautions for operation and maintenance.
  - f. Diagrams and illustrations.
  - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
  - h. Performance data.
  - i. Pictorial "exploded" parts list with part numbers. Emphasis shall

be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.

- j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.

H. After approval and prior to installation, furnish the Contracting Officer Representative with one sample of each of the following:

1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
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, lighting control 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**

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

#### **1.14 ACCEPTANCE CHECKS AND TESTS**

- A. The Contractor shall furnish the instruments, materials, and labor for tests.
- B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
- C. When test results indicate any defects, the Contractor shall repair or

replace the defective materials or equipment, and repeat the tests.  
Repair, replacement, and retesting shall be accomplished at no  
additional cost to the Government.

**1.15 WARRANTY**

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

**1.16 INSTRUCTION**

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

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

**PART 3 - EXECUTION (NOT USED)**

---END---

**SECTION 26 05 19**

**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

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

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 QUALITY ASSURANCE**

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

**1.4 FACTORY TESTS**

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

**1.5 SUBMITTALS**

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

1. Shop Drawings:

- a. Submit sufficient information to demonstrate compliance with drawings and specifications.
- b. Submit the following data for approval:
  - 1) Electrical ratings and insulation type for each conductor and cable.
  - 2) Splicing materials and pulling lubricant.

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

- a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

## 1.6 APPLICABLE PUBLICATIONS

- 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):
- D2301-10.....Standard Specification for Vinyl Chloride  
Plastic Pressure-Sensitive Electrical  
Insulating Tape
  - D2304-10.....Test Method for Thermal Endurance of Rigid  
Electrical Insulating Materials
  - D3005-10.....Low-Temperature Resistant Vinyl Chloride  
Plastic Pressure-Sensitive Electrical  
Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):
- WC 70-09.....Power Cables Rated 2000 Volts or Less for the  
Distribution of Electrical Energy
- D. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
- 44-10.....Thermoset-Insulated Wires and Cables
  - 83-08.....Thermoplastic-Insulated Wires and Cables
  - 467-07.....Grounding and Bonding Equipment
  - 486A-486B-03.....Wire Connectors
  - 486C-04.....Splicing Wire Connectors
  - 486D-05.....Sealed Wire Connector Systems
  - 486E-09.....Equipment Wiring Terminals for Use with  
Aluminum and/or Copper Conductors
  - 493-07.....Thermoplastic-Insulated Underground Feeder and  
Branch Circuit Cables
  - 514B-04.....Conduit, Tubing, and Cable Fittings

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.

B. All conductors shall be copper.

C. Single Conductor and Cable:

1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
2. No. 8 AWG and larger: Stranded.
3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
4. Insulation: THHN-THWN

## **2.2 SPLICES**

A. Splices shall be in accordance with NEC and UL.

B. Above Ground Splices for No. 10 AWG and Smaller:

1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:

1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.
4. All bolts, nuts, and washers used with splices shall be zinc-plated steel.

D. Underground Splices for No. 10 AWG and Smaller:

1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be

strictly followed.

E. Underground Splices for No. 8 AWG and Larger:

1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

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

### **2.3 CONNECTORS AND TERMINATIONS**

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

### **2.4 CONTROL WIRING**

- A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

### **2.5 WIRE LUBRICATING COMPOUND**

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

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.



- B. Install all conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.
- G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
- I. Conductor and Cable Pulling:
  - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
  - 2. Use nonmetallic pull ropes.
  - 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
  - 4. All conductors in a single conduit shall be pulled simultaneously.
  - 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. No more than three branch circuits shall be installed in any one conduit.
- K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

### **3.2 SPLICE AND TERMINATION INSTALLATION**

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations

at no additional cost to the Government.

### **3.3 CONDUCTOR IDENTIFICATION**

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

### **3.4 FEEDER CONDUCTOR IDENTIFICATION**

- A. In each interior pullbox and each underground handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

### **3.5 EXISTING CONDUCTORS**

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

### **3.6 CONTROL WIRING INSTALLATION**

- A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.
- B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

### **3.7 CONTROL 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 handhole, install embossed brass tags to identify the system served and function.

### **3.8 ACCEPTANCE CHECKS AND TESTS**

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests: Inspect physical condition.
  - 2. Electrical tests:

- a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
- b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
- c. Perform phase rotation test on all three-phase circuits.

---END---



**SECTION 26 05 26**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 QUALITY ASSURANCE**

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

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
  - 2. Test Reports:
    - a. Two weeks prior to the final inspection, submit ground resistance field test reports to the Contracting Officer Representative.
  - 3. Certifications:
    - a. Certification by the Contractor that the grounding equipment has been properly installed 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. 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
  - B8-11.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- 81-83.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- D. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code (NEC)
  - 70E-12.....National Electrical Safety Code
  - 99-12.....Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
- 44-10 .....Thermoset-Insulated Wires and Cables
  - 83-08 .....Thermoplastic-Insulated Wires and Cables
  - 467-07 .....Grounding and Bonding Equipment

## **PART 2 - PRODUCTS**

### **2.1 GROUNDING AND BONDING CONDUCTORS**

- A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
- B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.

C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

D. Insulation: THHN-THWN.

## **2.2 GROUND RODS**

A. Copper clad steel 19 mm (0.75 inch) diameter by 3 M (10 feet) long.

B. Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

## **2.3 GROUND CONNECTIONS**

A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.

B. Above Grade:

1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger: use compression-type connectors. For wire sizes smaller than No. 8 AWG: use mechanical type lugs. Connectors or lugs shall use cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

A. Install grounding equipment in accordance with the NEC, as shown on the drawings, and as specified herein.

B. System Grounding:

1. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

### **3.2 INACCESSIBLE GROUNDING CONNECTIONS**

A. Make grounding connections, which are normally buried or otherwise

inaccessible, by exothermic weld.

### **3.3 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS**

#### **A. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):**

1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.

#### **B. Panelboards and other electrical equipment:**

1. Connect the equipment grounding conductors to the ground bus.
2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.

#### **C. 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.

### **3.4 RACEWAY**

#### **A. Conduit Systems:**

1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect



- bushings with a equipment grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (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. 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.
- E. Ground lighting fixtures to the equipment grounding conductor of the wiring system. 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.
- F. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

### **3.5 OUTDOOR METALLIC FENCES AROUND ELECTRICAL EQUIPMENT**

- A. Fences shall be grounded as shown on the drawings. Fences shall be grounded with a ground rod at each fixed gate post and at each corner post.
- B. Drive ground rods until the top is 300 mm (12 inches) below grade. Attach a No. 4 AWG copper conductor by exothermic weld to the ground rods, and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 300 mm (12 inches) of fence mesh and fasten by two approved bronze compression fittings, one to bond the wire to post and the other to bond the wire to fence. Each gate section shall be bonded to its gatepost by a 3 mm x 25 mm (0.375 inch x 1 inch) flexible, braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

### **3.6 CORROSION INHIBITORS**

- A. When making grounding and bonding connections, apply a corrosion

inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

### **3.7 EXTERIOR LIGHT POLES**

- A. Provide 6.1 M (20 feet) of No. 4 AWG bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation as required to reach pole ground stud.

### **3.8 GROUND RESISTANCE**

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

### **3.9 GROUND ROD INSTALLATION**

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

### **3.10 ACCEPTANCE CHECKS AND TESTS**

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

provided.

- C. Below-grade connections shall be visually inspected by the Contracting Officer Representative prior to backfilling. The Contractor shall notify the Contracting Officer Representative 24 hours before the connections are ready for inspection.

---END---



**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. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Size and location of main feeders.
    - b. Size and location of panels and pull-boxes.
    - c. Layout of required conduit penetrations through structural elements.
    - d. Submit the following data for approval:
      - 1) Raceway types and sizes.
      - 2) Conduit bodies, connectors and fittings.
      - 3) Junction and pull boxes, types and sizes.
  - 2. Certifications: Two weeks prior to final inspection, submit the following:
    - a. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.

- b. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have 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
  - C80.3-05.....Steel Electrical Metal Tubing
  - C80.6-05.....Electrical Intermediate Metal Conduit
- C. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
- 1-05.....Flexible Metal Conduit
  - 5-11.....Surface Metal Raceway and Fittings
  - 6-07.....Electrical Rigid Metal Conduit - Steel
  - 50-95.....Enclosures for Electrical Equipment
  - 360-13.....Liquid-Tight Flexible Steel Conduit
  - 467-13.....Grounding and Bonding Equipment
  - 514A-13.....Metallic Outlet Boxes
  - 514B-12.....Conduit, Tubing, and Cable Fittings
  - 514C-07.....Nonmetallic Outlet Boxes, Flush-Device Boxes  
and Covers
  - 651-11.....Schedule 40 and 80 Rigid PVC Conduit and  
Fittings
  - 651A-11.....Type EB and A Rigid PVC Conduit and HDPE  
Conduit
  - 797-07.....Electrical Metallic Tubing
  - 1242-06.....Electrical Intermediate Metal Conduit - Steel
- E. National Electrical Manufacturers Association (NEMA):
- TC-2-13.....Electrical Polyvinyl Chloride (PVC) Tubing and  
Conduit
  - TC-3-13.....PVC Fittings for Use with Rigid PVC Conduit and  
Tubing

FB1-12.....Fittings, Cast Metal Boxes and Conduit Bodies  
for Conduit, Electrical Metallic Tubing and  
Cable

FB2.10-13.....Selection and Installation Guidelines for  
Fittings for use with Non-Flexible Conduit or  
Tubing (Rigid Metal Conduit, Intermediate  
Metallic Conduit, and Electrical Metallic  
Tubing)

FB2.20-12.....Selection and Installation Guidelines for  
Fittings for use with Flexible Electrical  
Conduit and Cable

F. American Iron and Steel Institute (AISI):

S100-2007.....North American Specification for the Design of  
Cold-Formed Steel Structural Members

**PART 2 - PRODUCTS**

**2.1 MATERIAL**

A. Conduit Size: In accordance with the NEC, but not less than 13 mm  
(0.5-inch) unless otherwise shown. Where permitted by the NEC, 13 mm  
(0.5-inch) flexible conduit may be used for tap connections to recessed  
lighting fixtures.

B. Conduit:

1. Size: In accordance with the NEC, but not less than 13 mm (0.5-  
inch).
2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and ANSI C80.1.
3. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242  
and ANSI C80.6.
4. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and ANSI  
C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be  
permitted only with cable rated 600 V or less.
5. Flexible Metal Conduit: Shall conform to UL 1.
6. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.
7. Direct Burial Plastic Conduit: Shall conform to UL 651 and UL 651A,  
heavy wall PVC or high density polyethylene (PE).

C. Conduit Fittings:

1. Rigid Steel and Intermediate Metallic 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.
3. Electrical Metallic Tubing Fittings:
- a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Compression Couplings and Connectors: Concrete-tight and rain-tight, with connectors having insulated throats.
  - d. Setscrew Couplings and Connectors: Use setscrews of case-hardened steel with hex head and cup point, to firmly seat in wall of conduit for positive grounding.
  - e. Indent-type connectors or couplings are prohibited.
  - f. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
4. Flexible Metal Conduit Fittings:
- a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.



- b. Clamp-type, with insulated throat.
- 5. Liquid-tight Flexible Metal Conduit Fittings:
  - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
- 6. Direct Burial Plastic Conduit Fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.
- 7. Expansion and Deflection Couplings:
  - a. Conform to UL 467 and UL 514B.
  - b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
  - c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and 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 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
  - 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
  - 1. UL-50 and UL-514A.
  - 2. Rustproof cast metal where required by the NEC or shown on drawings.
  - 3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.

### **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 Contracting Officer Representative 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 when permitted by the Contracting Officer Representative where working space is limited.

B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.

#### **3.2 INSTALLATION, GENERAL**

- A. In accordance with UL, NEC, NEMA, as shown on drawings, and as specified herein.
- B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.
- 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 conduits.

4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut conduits square, ream, remove burrs, and draw up tight.
6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
10. Conduit installations under fume and vent hoods are prohibited.
11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
12. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
13. 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 and approved by the Contracting Officer Representative .

### 3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
  2. Align and run conduit in direct lines.
  3. Install conduit through concrete beams only:
    - a. Where shown on the structural drawings.
    - b. As approved by the Contracting Officer Representative prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
  4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
    - a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
    - b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.
    - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (0.75-inch) of concrete around the conduits.
  5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.
- B. Above Furred or Suspended Ceilings and in Walls:
1. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the same system is prohibited.
  2. Align and run conduit parallel or perpendicular to the building lines.
  3. Tightening set screws with pliers is prohibited.
  4. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.

### **3.4 EXPOSED WORK INSTALLATION**

- A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the system is prohibited.

- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.
- G. Surface Metal Raceways: Use only where shown on drawings.
- H. Painting:
  - 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
  - 2. Paint all conduits containing cables rated over 600 V safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6 M (20 feet) intervals in between.

### **3.5 DIRECT BURIAL INSTALLATION**

Refer to Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

### **3.6 WET OR DAMP LOCATIONS**

- A. Use rigid steel or IMC conduits unless as shown on drawings.
- B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.
- C. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.
- D. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

### **3.7 MOTORS AND VIBRATING EQUIPMENT**

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

- B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.
- C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

### **3.8 EXPANSION JOINTS**

- A. Conduits 75 mm (3 inch) and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inch) with junction boxes on both sides of the expansion joint. Connect flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5 inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.
- C. Install expansion and deflection couplings where shown.
- D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper bonding jumper installed.

### **3.9 CONDUIT SUPPORTS**

- 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 an additional 90 kg (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 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.
  - b. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).
  - c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts.

G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.

L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

### **3.10 BOX INSTALLATION**

A. Boxes for Concealed Conduits:

1. Flush-mounted.
2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90 degree bends are necessary.

C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.

- D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.
- F. 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.
- G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.
- H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."
- I. On all branch circuit junction box covers, identify the circuits with black marker.

- - - E N D - - -



**SECTION 26 05 41**  
**UNDERGROUND ELECTRICAL CONSTRUCTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of underground ducts and raceways, and precast manholes and pullboxes to form a complete underground electrical raceway system.
- B. The terms "duct" and "conduit" are used interchangeably in this section.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Coordinate layout and installation of ducts, manholes, and pullboxes with final arrangement of other utilities, site grading, and surface features

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Submit information on manholes, pullboxes, ducts, and hardware. Submit manhole plan and elevation drawings, showing openings, pulling irons, cable supports, cover, ladder, sump, and other accessories.
    - c. Proposed deviations from the drawings shall be clearly marked on the submittals. If it is necessary to locate manholes, pullboxes, or duct banks at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit to the Contracting Officer Representative for approval prior to construction.

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

- 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.

#### 1.5 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 Concrete Institute (ACI):

Building Code Requirements for Structural Concrete

318-11/318M-11.....Building Code Requirements for Structural  
Concrete & Commentary

SP-66-04.....ACI Detailing Manual

C. American National Standards Institute (ANSI):

77-10.....Underground Enclosure Integrity

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

C478-12.....Standard Specification for Precast Reinforced  
Concrete Manhole Sections

C858-10e1.....Underground Precast Concrete Utility Structures

C990-09.....Joints for Concrete Pipe, Manholes and Precast  
Box Sections Using Preformed Flexible Joint  
Sealants.

E. National Electrical Manufacturers Association (NEMA):

TC 2-03.....Electrical Polyvinyl Chloride (PVC) Conduit

TC 3-04.....Polyvinyl Chloride (PVC) Fittings for Use With  
Rigid PVC Conduit And Tubing

TC 6 & 8-03.....Polyvinyl Chloride (PVC) Plastic Utilities Duct  
For Underground Installations

TC 9-04.....Fittings For Polyvinyl Chloride (PVC) Plastic  
Utilities Duct For Underground Installation

F. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

70E-12.....National Electrical Safety Code

G. Underwriters Laboratories, Inc. (UL):

- 6-07.....Electrical Rigid Metal Conduit-Steel
- 467-07.....Grounding and Bonding Equipment
- 651-11.....Schedule 40, 80, Type EB and A Rigid PVC  
Conduit and Fittings
- 651A-11.....Schedule 40 and 80 High Density Polyethylene  
(HDPE) Conduit
- 651B-07.....Continuous Length HDPE Conduit

**PART 2 - PRODUCTS**

**2.1 PULLBOXES**

- A. General: Size as indicated on the drawings. Provide pullboxes with weatherproof, non-skid covers with recessed hook eyes, secured with corrosion- and tamper-resistant hardware. Cover material shall be identical to pullbox material. Covers shall have molded lettering, ELECTRIC or SIGNAL as applicable. Pullboxes shall comply with the requirements of ANSI 77 Tier 5 loading. Provide pulling irons, 22 mm (0.875 inch) diameter galvanized steel bar with exposed triangular-shaped opening.
- B. Polymer Concrete Pullboxes: Shall be molded of sand, aggregate, and polymer resin, and reinforced with steel, fiberglass, or both. Pullbox shall have open bottom.
- C. Concrete Pullboxes: Shall be monolithically-poured reinforced concrete.

**2.2 DUCTS**

- A. Number and sizes shall be as shown on the drawings.
- B. Ducts (concrete-encased):
  - 1. Plastic Duct:
    - a. UL 651 and 651A Schedule 40 PVC conduit
    - b. Duct shall be suitable for use with 90° C (194° F) rated conductors.
  - 2. Conduit Spacers: Prefabricated plastic.
- C. Ducts (direct-burial):
  - 1. Plastic duct:
    - a. UL 651, 651A, and 651B, Schedule 40 PVC or HDPE conduit
    - b. Duct shall be suitable for use with 75° C (167° F) rated

conductors.

2. Rigid metal conduit: UL6 and NEMA RN1 galvanized rigid metal, half-lap wrapped with 10 mil PVC tape.

### **2.3 GROUNDING**

- A. Ground Rods and Ground Wire: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

### **2.4 WARNING TAPE**

- A. 4-mil polyethylene 75 mm (3 inches) wide detectable tape, red with black letters, imprinted with "CAUTION - BURIED ELECTRIC CABLE BELOW" or similar.

### **2.5 PULL ROPE FOR SPARE DUCTS**

- A. Plastic with 890 N (200 lb) minimum tensile strength

## **PART 3 - EXECUTION**

### **3.1 PULLBOX INSTALLATION**

- A. Assembly and installation shall be per the requirements of the manufacturer.
  1. Install manholes and pullboxes level and plumb.
  2. Units shall be installed on a 300 mm (12 inches) thick level bed of 90% compacted granular fill, well-graded from the 25 mm (1 inches) sieve to the No. 4 sieve. Granular fill shall be compacted with a minimum of four passes with a plate compactor.
- B. Access: Ensure the top of frames and covers are flush with finished grade.

### **3.2 TRENCHING**

- A. Before performing trenching work at existing facilities, a Ground Penetrating Radar Survey shall be carefully performed by a certified technician to reveal all existing underground ducts, conduits, cables, and other utility systems.
- B. Work with extreme care near existing ducts, conduits, and other utilities to avoid damaging them.
- C. Cut the trenches neatly and uniformly.
- D. For Concrete-Encased Ducts:
  1. After excavation of the trench, stakes shall be driven in the bottom of the trench at 1.2 M (4 foot) intervals to establish the grade and

- route of the duct bank.
2. Pitch the trenches uniformly toward manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts toward buildings wherever possible.
  3. The walls of the trench may be used to form the side walls of the duct bank, provided that the soil is self-supporting and that the concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.
  4. After the concrete-encased duct has sufficiently cured, the trench shall be backfilled to grade with earth, and appropriate warning tape installed.
- F. Individual conduits to be installed under existing paved areas and roads that cannot be disturbed shall be jacked into place using rigid metal conduit, or bored using plastic utilities duct or PVC conduit, as approved by the Contracting Officer Representative.

### **3.3 DUCT INSTALLATION**

#### **A. General Requirements:**

1. Ducts shall be in accordance with the NEC, as shown on the drawings, and as specified.
2. Join and terminate ducts with fittings recommended by the manufacturer.
3. Slope ducts to drain towards manholes and pullboxes, and away from building and equipment entrances. Pitch not less than 100 mm (4 inch) in 30 M (100 feet).
4. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 1.5 M (5 feet) outside the building foundation. Tops of conduits below building slab shall be minimum 610 mm (24 inches) below bottom of slab.
5. Stub-ups and sweeps to equipment mounted on outdoor concrete slabs shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 1.5 M (5 feet) away from the edge of slab.
6. Install insulated grounding bushings on the conduit terminations.
7. Radius for sweeps shall be sufficient to accomplish pulls without damage. Minimum radius shall be six times conduit diameter.

8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 75 mm (3 inches) above the bottom of the trench during the concrete pour. Spacer spacing shall not exceed 1.5 M (5 feet). Secure spacers to ducts and earth to prevent floating during concrete pour. Provide nonferrous tie wires to prevent displacement of the ducts during concrete pour. Tie wires shall not act as substitute for spacers.
  9. Duct lines shall be installed no less than 300 mm (12 inches) from other utility systems, such as water, sewer, chilled water.
  10. Clearances between individual ducts:
    - a. For similar services, not less than 75 mm (3 inches).
    - b. For power and signal services, not less than 150 mm (6 inches).
  11. Duct lines shall terminate at window openings in manhole walls as shown on the drawings. All ducts shall be fitted with end bells.
  12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to ensure maximum strength and rigidity of the duct bank.
  13. Keep ducts clean of earth, sand, or gravel, and seal with tapered plugs upon completion of each portion of the work.
  14. Spare Ducts: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.
  15. Duct Identification: Place continuous strip of warning tape approximately 300 mm (12 inches) above ducts before backfilling trenches. Warning tape shall be preprinted with proper identification.
  16. Duct Sealing: Seal ducts, including spare ducts, at building entrances and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of foreign objects and material, moisture, and gases.
  17. Use plastic ties to secure cables to insulators on cable arms. Use minimum two ties per cable per insulator.
- B. Concrete-Encased Ducts:
1. Install concrete-encased ducts for medium-voltage systems, low-voltage systems, and signal systems, unless otherwise shown on the drawings.
  2. Duct banks shall be single or multiple duct assemblies encased in

concrete. Ducts shall be uniform in size and material throughout the installation.

3. Tops of concrete-encased ducts shall be:
  - a. Not less than 600 mm (24 inches) and not less than shown on the drawings, below finished grade.
  - b. Not less than 750 mm (30 inches) and not less than shown on the drawings, below roads and other paved surfaces.
  - c. Additional burial depth shall be required in order to accomplish NEC-required minimum bend radius of ducts.
  - d. Conduits crossing under grade slab construction joints shall be installed a minimum of 1.2 M (4 feet) below slab.
4. Extend the concrete envelope encasing the ducts not less than 75 mm (3 inches) beyond the outside walls of the outer ducts.
5. Within 3 M (10 feet) of building and manhole wall penetrations, install reinforcing steel bars at the top and bottom of each concrete envelope to provide protection against vertical shearing.
6. Install reinforcing steel bars at the top and bottom of each concrete envelope of all ducts underneath roadways and parking areas.
7. Where new ducts and concrete envelopes are to be joined to existing manholes, pullboxes, ducts, and concrete envelopes, make the joints with the proper fittings and fabricate the concrete envelopes to ensure smooth durable transitions.
8. Duct joints in concrete may be placed side by side horizontally, but shall be staggered at least 150 mm (6 inches) vertically.
9. Pour each run of concrete envelope between manholes or other terminations in one continuous pour. If more than one pour is necessary, terminate each pour in a vertical plane and install 19 mm (0.75 inch) reinforcing rod dowels extending 450 mm (18 inches) into concrete on both sides of joint near corners of envelope.
10. Pour concrete so that open spaces are uniformly filled. Do not agitate with power equipment unless approved by Contracting Officer Representative.

C. Direct-Burial Ducts:

1. Install direct-burial ducts only where shown on the drawings. Provide direct-burial ducts only for low-voltage power and lighting branch circuits.

2. Tops of ducts shall be:
  - a. Not less than 600 mm (24 inches) and not less than shown on the drawings, below finished grade.
  - b. Not less than 750 mm (30 inches) and not less than shown on the drawings, below roads and other paved surfaces.
  - c. Additional burial depth shall be required in order to accomplish NEC-required minimum bend radius of ducts.
3. Do not kink the ducts. Compaction shall not deform the ducts.
- D. Connections to Existing Ducts: Where connections to existing ducts are indicated, excavate around the ducts as necessary. Cut off the ducts and remove loose concrete from inside before installing new ducts. Provide a reinforced-concrete collar, poured monolithically with the new ducts, to take the shear at the joint of the duct banks.
- G. Partially-Completed Ducts: During construction, wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable plugs. Fit concrete envelope of a partially completed ducts with reinforcing steel extending a minimum of 600 mm (2 feet) back into the envelope and a minimum of 600 mm (2 feet) beyond the end of the envelope. Provide one No. 4 bar in each corner, 75 mm (3 inches) from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 300 mm (12 inches) apart. Restrain reinforcing assembly from moving during pouring of concrete.

### **3.4 ACCEPTANCE CHECKS AND TESTS**

- A. Duct Testing and Cleaning:
  1. Upon completion of the duct installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the duct, and to test for out-of-round conditions.
  2. The mandrel shall be not less than 300 mm (12 inches) long, and shall have a diameter not less than 13 mm (0.5 inch) less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.
  3. If testing reveals obstructions or out-of-round conditions, the



Contractor shall replace affected section(s) of duct and retest to the satisfaction of the Contracting Officer Representative at no cost to the Government.

4. Mandrel pulls shall be witnessed by the Contracting Officer Representative.

---END---



**SECTION 26 08 00**  
**COMMISSIONING OF ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 26.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 SUMMARY**

- A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

**1.4 DEFINITIONS**

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

**1.5 COMMISSIONED SYSTEMS**

- A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the VA and the Commissioning Agent.
- B. The Facility electrical systems commissioning will include the systems

listed in Section 01 19 00 General Commissioning Requirements:

#### **1.6 SUBMITTALS**

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

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

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

##### **3.1 CONSTRUCTION INSPECTIONS**

- A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 19 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

##### **3.2 PRE-FUNCTIONAL CHECKLISTS**

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist

to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

### **3.3 CONTRACTORS TESTS**

- A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

### **3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING**

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Contracting Officer Representative. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

### **3.5 TRAINING OF VA PERSONNEL**

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Contracting Officer Representative and

Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 19 00. The instruction shall be scheduled in coordination with the VA Contracting Officer Representative after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

----- END -----

**SECTION 26 22 00**  
**LOW-VOLTAGE TRANSFORMERS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of low-voltage dry-type general-purpose transformers, indicated as transformers in this section.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 QUALITY ASSURANCE**

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

**1.4 SUBMITTALS**

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

1. Shop Drawings:

- a. Submit sufficient information to demonstrate compliance with drawings and specifications.
- b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, temperature rise, wiring and connection diagrams, plan, front, side, and rear elevations, accessories, and device nameplate data.
- c. Certification from the manufacturer that representative transformers have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:

- a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets and wiring diagrams.
  - 1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the

transformers.

- 2) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
  - a. Certification by the manufacturer that the transformers conform to the requirements of the drawings and specifications.
  - b. Certification by the Contractor that the transformers have been properly installed, adjusted, and tested.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):  
IBC-12.....International Building Code
- C. National Fire Protection Association (NFPA):  
70-11.....National Electrical Code (NEC)
- D. National Electrical Manufacturers Association (NEMA):  
TP1-02.....Guide for Determining Energy Efficiency for  
Distribution Transformers  
TR1-00.....Transformers, Regulators, and Reactors
- E. Underwriters Laboratories, Inc. (UL):  
UL 506-08.....Standard for Specialty Transformers  
UL 1561-11.....Dry-Type General Purpose and Power Transformers
- F. United States Department of Energy  
10 CFR Part 431.....Energy Efficiency Program for Certain  
Commercial and Industrial Equipment

## **PART 2 - PRODUCTS**

### **2.1 TRANSFORMERS**

- A. Unless otherwise specified, transformers shall be in accordance with



NEMA, NEC, UL and as shown on the drawings.

B. Transformers shall have the following features:

1. Self-cooled by natural convection, isolating windings, indoor and outdoor dry-type. Autotransformers will not be accepted, except as specifically allowed for buck-boost applications.
2. Rating and winding connections shall be as shown on the drawings.
3. Ratings shown on the drawings are for continuous duty without the use of cooling fans.
4. Copper windings.
5. Insulation systems:
  - a. Transformers 30 kVA and larger: UL rated 220 °C (428 °F) system with an average maximum rise by resistance of 150 °C (302 °F) in a maximum ambient of 40 °C (104 °F).
  - b. Transformers below 30 kVA: Same as for 30 kVA and larger or UL rated 185 °C (365 °F) system with an average maximum rise by resistance of 115 °C (239 °F) in a maximum ambient of 40 °C (104 °F).
6. Core and coil assemblies:
  - a. Rigidly braced to withstand the stresses caused by short-circuit currents and rough handling during shipment.
  - b. Cores shall be grain-oriented, non-aging, and silicon steel.
  - c. Coils shall be continuous windings without splices except for taps.
  - d. Coil loss and core loss shall be minimized for efficient operation.
  - e. Primary and secondary tap connections shall be brazed or pressure type.
  - f. Coil windings shall have end filters or tie-downs for maximum strength.
7. Certified sound levels, determined in accordance with NEMA, shall not exceed the following:

Transformer Rating	Sound Level Rating
0 - 9 KVA	40 dB
10 - 50 KVA	45 dB
51 - 150 KVA	50 dB
151 - 300 KVA	55 dB
301 - 500 KVA	60 dB

8. If not shown on drawings, nominal impedance shall be as permitted by NEMA.
9. Single phase transformers rated 15 kVA through 25 kVA shall have two 5% full capacity taps below normal rated primary voltage. All transformers rated 30 kVA and larger shall have two 2.5% full capacity taps above, and four 2.5% full capacity taps below normal rated primary voltage.
10. Core assemblies shall be grounded to their enclosures with adequate flexible ground straps.
11. Enclosures:
  - a. Comprised of not less than code gauge steel.
  - b. Outdoor enclosures shall be NEMA 3R.
  - c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
  - d. Ventilation openings shall prevent accidental access to live components.
  - e. The enclosure at the factory shall be thoroughly cleaned and painted with manufacturer's prime coat and standard finish.
12. Standard NEMA features and accessories, including ground pad, lifting provisions, and nameplate with the wiring diagram and sound level indicated.
13. Dimensions and configurations shall conform to the spaces designated for their installations.
14. Transformers shall meet the minimum energy efficiency values per NEMA TP1 as listed below:

kVA Rating	Output efficiency (%)
15	97
30	97.5
45	97.7
75	98
112.5	98.2
150	98.3
225	98.5
300	98.6
500	98.7
750	98.8

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation of transformers shall be in accordance with the NEC, as recommended by the equipment manufacturer and as shown on the drawings.
- B. Anchor transformers with rustproof bolts, nuts, and washers, in accordance with manufacturer's instructions, and as shown on drawings.
- C. In seismic areas, transformers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- D. Exterior Location: Mount transformers on concrete slab. Unless otherwise indicated, the slab shall be at least 200 mm (8 inches) thick, reinforced with a 150 by 150 mm (6 by 6 inches) No. 6 mesh placed uniformly 100 mm (4 inches) from the top of the slab. Slab shall be placed on a 150 mm (6 inches) thick, well-compacted gravel base. The top of the concrete slab shall be approximately 100 mm (4 inches) above the finished grade. Edges above grade shall have 15 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 200 mm

(8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

- E. Install transformers with manufacturer's recommended clearance from wall and adjacent equipment for air circulation. Minimum clearance shall be 150 mm (6 inches).
- F. Install transformers on vibration pads designed to suppress transformer noise and vibrations.

### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform tests in accordance with the manufacturer's recommendations.

In addition, include the following:

- 1. Visual Inspection and Tests:

- a. Compare equipment nameplate data with specifications and approved shop drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections.
- d. Perform specific inspections and mechanical tests as recommended by manufacturer.
- e. Verify correct equipment grounding.
- f. Verify proper secondary phase-to-phase and phase-to-neutral voltage after energization and prior to connection to loads.

### **3.3 FOLLOW-UP VERIFICATION**

- A. Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the transformers are in good operating condition, and properly performing the intended function.

---END---

**SECTION 26 29 21**  
**ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 QUALITY ASSURANCE**

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

**1.4 SUBMITTALS**

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

1. Shop Drawings:

- a. Submit sufficient information to demonstrate compliance with drawings and specifications.
- b. Submit the following data for approval:
  - 1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.
- c. Certification from the manufacturer that representative enclosed switches and circuit breakers have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:

- a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
  - 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.

- 2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
  - a. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.
  - b. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):  
IBC-12.....International Building Code
- C. National Electrical Manufacturers Association (NEMA):  
FU 1-07.....Low Voltage Cartridge Fuses  
KS 1-06.....Enclosed and Miscellaneous Distribution  
Equipment Switches (600 Volts Maximum)
- D. National Fire Protection Association (NFPA):  
70-11.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):  
98-07.....Enclosed and Dead-Front Switches  
248-00.....Low Voltage Fuses  
489-09.....Molded Case Circuit Breakers and Circuit  
Breaker Enclosures

#### **PART 2 - PRODUCTS**

##### **2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS**

- A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.
- B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA

classified Heavy Duty (HD) for 480 V switches.

C. Shall be horsepower (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 open position.
3. An arc chute for each pole.
4. External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
5. Mechanical interlock shall permit opening of the door only when the switch is in the open 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.
  - b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
  - c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.

## **2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS**

A. Shall be the same as fused switches, but without provisions for fuses.

## **2.3 CARTRIDGE FUSES**

- A. Shall be in accordance with NEMA FU 1.
- B. Service Entrance: Class RK1, time delay
- C. Feeders: Class RK1, fast acting// Class RK1, time delay
- E. Other Branch Circuits: Class RK1, time delay
- F. Control Circuits: Class CC, fast acting

## **2.6 SEPARATELY-ENCLOSED CIRCUIT BREAKERS**

- A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.
- B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

## **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. In seismic areas, enclosed switches and circuit breakers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- C. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests:
    - a. Compare equipment nameplate data with specifications and approved shop drawings.
    - b. Inspect physical, electrical, and mechanical condition.
    - c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
    - d. Vacuum-clean enclosure interior. Clean enclosure exterior.

### **3.3 SPARE PARTS**

- A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the Contracting Officer Representative .

---END---



**SECTION 27 05 11**  
**REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section, Requirements for Communications Installations, applies to all sections of Division 27.
- B. Furnish and install communications cabling, systems, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of transformers, cable, and other items and arrangements for the specified items are shown on drawings.

**1.2 MINIMUM REQUIREMENTS**

- A. References to industry and trade association standards and codes are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

**1.3 QUALIFICATIONS (PRODUCTS AND SERVICES)**

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

**1.4 MANUFACTURED PRODUCTS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  - 1. Components of an assembled unit need not be products of the same manufacturer.
  - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
  - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
  - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Contracting Officer Representative 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 Contracting Officer Representative prior to final inspection and not more than 90 days after completion of the tests.
  - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

#### **1.5 EQUIPMENT REQUIREMENTS**

Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

#### **1.6 EQUIPMENT PROTECTION**

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
  - 1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
  - 2. Damaged equipment shall be, as determined by the Contracting Officer Representative, placed in first class operating condition or be returned to the source of supply for repair or replacement.
  - 3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
  - 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

#### **1.7 WORK PERFORMANCE**

- A. Job site safety and worker safety is the responsibility of the contractor.
- B. For work on existing stations, arrange, phase and perform work to assure communications service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and pathways with other trades to minimize interferences. See the GENERAL CONDITIONS.

#### **1.8 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Inaccessible Equipment:
  - 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.

2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

#### **1.9 EQUIPMENT IDENTIFICATION**

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

#### **1.10 SUBMITTALS**

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

nameplate data and test reports as required.

2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
3. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
4. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
  - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
  - b. A control sequence describing start-up, operation, and shutdown.
  - c. Description of the function of each principal item of equipment.

- d. Installation and maintenance instructions.
  - e. Safety precautions.
  - f. Diagrams and illustrations.
  - g. Testing methods.
  - h. Performance data.
  - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
  - j. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
- G. Approvals will be based on complete submission of manuals together with shop drawings.
- H. After approval and prior to installation, furnish the Contracting Officer Representative with one sample of each of the following:
- 1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
  - 2. Each type of conduit and pathway coupling, bushing and termination fitting.
  - 3. Raceway and pathway hangers, clamps and supports.
  - 4. Duct sealing compound.

#### **1.11 SINGULAR NUMBER**

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

#### **1.12 TRAINING**

- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the Contracting Officer Representative at least 30 days prior to the planned training.

DEPARTMENT OF VETERANS AFFAIRS  
PALO ALTO HEALTH CARE SYSTEM  
DESIGN FISHER HOUSE #2 SITE  
PREPARATION UTILITIES & LANDSCAPING

Project No.: 640-16-112

- - - E N D - - -





**SECTION 27 05 26**

**GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies general grounding and bonding requirements of telecommunication installations for equipment operations.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, telecommunications system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Contracting Officer Representative:
  - 1. Certification that the materials and installation is in accordance with the drawings and specifications.
  - 2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

**1.4 APPLICABLE PUBLICATIONS**

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic

designation only.

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

B1-2001.....Standard Specification for Hard-Drawn Copper  
Wire

B8-2004.....Standard Specification for Concentric-Lay-  
Stranded Copper Conductors, Hard, Medium-Hard,  
or Soft

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-1983.....IEEE Guide for Measuring Earth Resistivity,  
Ground Impedance, and Earth Surface Potentials  
of a Ground System

C. National Fire Protection Association (NFPA):

70-2005.....National Electrical Code (NEC)

D. Telecommunications Industry Association, (TIA)

J-STO-607-A-2002.....Commercial Building Grounding (Earthing) and  
Bonding Requirements for Telecommunications

E. Underwriters Laboratories, Inc. (UL):

44-2005 .....Thermoset-Insulated Wires and Cables

83-2003 .....Thermoplastic-Insulated Wires and Cables

467-2004 .....Grounding and Bonding Equipment

486A-486B-2003 .....Wire Connectors

## **PART 2 - PRODUCTS**

### **2.1 GROUNDING AND BONDING CONDUCTORS**

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm<sup>2</sup> (4 AWG) and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

### **2.2 SPLICES AND TERMINATION COMPONENTS**

Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

### **2.3 GROUND CONNECTIONS**

- A. Below Grade: Exothermic-welded type connectors.
- B. Above Grade:
  - 1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
  - 2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
  - 3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.
- A. Cable Shields: Make ground connections to multipair communications cables with metallic shields using shield bonding connectors with screw stud connection.

#### **2.4 SPLICE CASE GROUND ACCESSORIES**

Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.
- B. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

#### **3.2 INACCESSIBLE GROUNDING CONNECTIONS**

Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

#### **3.3 SECONDARY EQUIPMENT AND CIRCUITS**

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

building-mounted service entrance equipment need not contain an equipment grounding conductor.

3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

**B. Boxes, Cabinets, Enclosures, and Panelboards:**

1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

**3.4 TELECOMMUNICATIONS SYSTEM**

- A. Furnish and install all wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.
- B. Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.
- C. Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milli ohms or less.
- D. Below-Grade Grounding Connections: When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly cleaned the joint area. Notify the Contracting Officer Representative prior to backfilling any ground connections.
- E. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.

F. Bonding Jumpers:

1. Use insulated ground wire of the size and type shown on the Drawings or use a minimum of 16 mm<sup>2</sup> (6 AWG) insulated copper wire.
2. Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
3. Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.

H. Bonding Jumper Fasteners:

1. Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.

**3.5 COMMUNICATIONS CABLE GROUNDING**

- A. Bond all metallic cable sheaths in multipair communications cables together at each splicing and/or terminating location to provide 100 percent metallic sheath continuity throughout the communications distribution system.
1. At terminal points, install a cable shield bonding connector provide a screw stud connection for ground wire. Use a bonding jumper to connect the cable shield connector to an appropriate ground source like the rack or cabinet ground bar.
  2. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or the splice case grounding and bonding accessories provided by the splice case manufacturer. When an external ground connection is provided as part of splice closure, connect to an approved ground source and all other metallic components and equipment at that location.

**3.6 COMMUNICATIONS RACEWAY GROUNDING**

- A. Conduit: Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.

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**SECTION 27 05 33**

**RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, raceway systems. Raceways are required for all communications cabling unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 SUBMITTALS**

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

- A. Shop Drawings:
  - 1. Size and location of panels and pull boxes
  - 2. Layout of required conduit penetrations through structural elements.
  - 3. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Certification: Prior to final inspection, deliver to the Contracting Officer Representative four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

**1.4 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):
  - 70-05.....National Electrical Code (NEC)
- C. Underwriters Laboratories, Inc. (UL):
  - 1-03.....Flexible Metal Conduit

- 5-01.....Surface Metal Raceway and Fittings
- 6-03.....Rigid Metal Conduit
- 50-03.....Enclosures for Electrical Equipment
- 360-03.....Liquid-Tight Flexible Steel Conduit
- 467-01.....Grounding and Bonding Equipment
- 514A-01.....Metallic Outlet Boxes
- 514B-02.....Fittings for Cable and Conduit
- 514C-05.....Nonmetallic Outlet Boxes, Flush-Device Boxes  
and Covers
- 651-02.....Schedule 40 and 80 Rigid PVC Conduit
- 651A-03.....Type EB and A Rigid PVC Conduit and HDPE  
Conduit
- 797-03.....Electrical Metallic Tubing
- 1242-00.....Intermediate Metal Conduit
- D. National Electrical Manufacturers Association (NEMA):
  - TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and  
Tubing
  - FB1-03.....Fittings, Cast Metal Boxes and Conduit Bodies  
for Conduit, Electrical Metallic Tubing and  
Cable

## **PART 2 - PRODUCTS**

### **2.1 MATERIAL**

- A. Conduit Size: In accordance with the NEC, but not less than 13 mm (1/2 inch) unless otherwise shown. Where permitted by the NEC, 13 mm (1/2 inch) flexible conduit may be used for tap connections to recessed lighting fixtures.
- B. Conduit:
  - 1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
  - 2. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
  - 3. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
  - 4. Flexible galvanized steel conduit: Shall Conform to UL 1.
  - 5. Liquid-tight flexible metal conduit: Shall Conform to UL 360.



6. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).

C. Conduit Fittings:

1. Rigid steel and IMC conduit fittings:

- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
- a. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
- b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
- c. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
- d. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
- e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

2. Electrical metallic tubing fittings:

- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
- b. Only steel or malleable iron materials are acceptable.
- c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.

- d. Indent type connectors or couplings are prohibited.
- e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
- 3. Flexible steel conduit fittings:
  - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
  - b. Clamp type, with insulated throat.
- 4. Liquid-tight flexible metal conduit fittings:
  - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
- 5. Direct burial plastic conduit fittings:
  - a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
  - b. As recommended by the conduit manufacturer.
- 6. Expansion and deflection couplings:
  - a. Conform to UL 467 and UL 514B.
  - b. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
  - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
  - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
  - 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
  - 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
  - 3. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.

4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Junction, and Pull Boxes:

1. UL-50 and UL-514A.
2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.

F. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with "CAUTION BURIED COMMUNICATIONS CABLE BELOW".

**PART 3 - EXECUTION**

**3.1 PENETRATIONS**

A. Cutting or Holes:

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

B. Fire Stop: Where conduits, wireways, and other communications raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as

specified in Section 07 92 00, JOINT SEALANTS.

### **3.2 INSTALLATION, GENERAL**

#### **A. Install conduit as follows:**

1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically continuous.
6. Independently support conduit at 8'0" on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
12. Do not use aluminum conduits in wet locations.
13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

#### **B. Conduit Bends:**

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

#### **C. Layout and Homeruns:**

2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the // Contracting Officer Representative // COTR //.

### **3.3 CONCEALED WORK INSTALLATION**

- A. Furred or Suspended Ceilings and in Walls:
  1. Conduit for conductors above 600 volts:
    - a. Rigid steel or rigid aluminum.
    - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
  2. Conduit for conductors 600 volts and below:
    - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
  3. Align and run conduit parallel or perpendicular to the building lines.
  4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (six feet) of flexible metal conduit extending from a junction box to the fixture.
  5. Tightening set screws with pliers is prohibited.

### **3.4 EXPOSED WORK INSTALLATION**

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for conductors above 600 volts:
  1. Rigid steel or rigid aluminum.
  2. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
- C. Conduit for Conductors 600 volts and below:
  1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- G. Surface metal raceways: Use only where shown.
- H. Painting:

1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

### **3.5 EXPANSION JOINTS**

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.
- D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

### **3.6 CONDUIT SUPPORTS, INSTALLATION**

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.

- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
  - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
  - 2. Existing Construction:
    - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
    - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
    - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

### **3.7 BOX INSTALLATION**

- A. Boxes for Concealed Conduits:
  - 1. Flush mounted.
  - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet

metal boxes.

- D. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

### 3.11 COMMUNICATION SYSTEM CONDUIT

- A. Install the communication raceway system as shown on drawings.
- B. Minimum conduit size of 19 mm (3/4 inch), but not less than the size shown on the drawings.
- C. All conduit ends shall be equipped with insulated bushings.
- D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.
- E. Vertical conduits/sleeves through closets floors shall terminate not less than 75 mm (3 inches) below the floor and not less than 75 mm (3 inches) below the ceiling of the floor below.
- F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.
- G. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.
- H. All empty conduits located in communication closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- I. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)



2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

- J. Furnish and install 19 mm (3/4 inch) thick fire retardant plywood specified in Section 06 10 00, ROUGH CARPENTRY on the wall of communication closets where shown on drawings . Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.
- K. Furnish and pull wire in all empty conduits. (Sleeves through floor are exceptions).

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**SECTION 27 08 00**

**COMMISSIONING OF COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 27.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 SUMMARY**

- A. This Section includes requirements for commissioning the Facility communications systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

**1.4 DEFINITIONS**

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

**1.5 COMMISSIONED SYSTEMS**

- A. Commissioning of a system or systems specified in Division 27 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 27, is required in cooperation with the VA and the Commissioning Agent.

- B. The Facility exterior closure systems commissioning will include the systems listed in Section 01 19 00 General Commissioning Requirements:

#### **1.6 SUBMITTALS**

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

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

### **PART 3 - EXECUTION**

#### **3.1 CONSTRUCTION INSPECTIONS**

- A. Commissioning of Communications systems will require inspection of individual elements of the communications system construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 19 00 and the Commissioning plan to schedule communications systems inspections as required to support the Commissioning Process.

#### **3.2 PRE-FUNCTIONAL CHECKLISTS**

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not

accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

### **3.3 CONTRACTORS TESTS**

- A. Contractor tests as required by other sections of Division 27 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

### **3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:**

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Contracting Officer Representative. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

### **3.5 TRAINING OF VA PERSONNEL**

- A. Training of the VA operation and maintenance personnel is required in

cooperation with the Contracting Officer Representative and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 19 00. The instruction shall be scheduled in coordination with the VA Contracting Officer Representative after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 27 Sections for additional Contractor training requirements.

----- END -----

**SECTION 27 10 00**  
**STRUCTURED CABLING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of the structured cabling system to provide a comprehensive telecommunications infrastructure.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
1. Manufacturer's Literature and Data: Showing each cable type and rating.
  2. Certificates: Two weeks prior to final inspection, deliver to the Contracting Officer Representative four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

**1.4 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):  
D2301-04.....Standard Specification for Vinyl Chloride  
Plastic Pressure Sensitive Electrical  
Insulating Tape
- C. Federal Specifications (Fed. Spec.):  
A-A-59544-00.....Cable and Wire, Electrical (Power, Fixed  
Installation)
- D. National Fire Protection Association (NFPA):  
70-05.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):  
44-02.....Thermoset-Insulated Wires and Cables

83-03.....	Thermoplastic-Insulated Wires and Cables
467-01.....	Electrical Grounding and Bonding Equipment
486A-01.....	Wire Connectors and Soldering Lugs for Use with Copper Conductors
486C-02.....	Splicing Wire Connectors
486D-02.....	Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
486E-00.....	Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-01.....	Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
514B-02.....	Fittings for Cable and Conduit
1479-03.....	Fire Tests of Through-Penetration Fire Stops

## **PART 2 - PRODUCTS**

### **2.1 CONTROL WIRING**

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

### **2.2 COMMUNICATION AND SIGNAL WIRING**

- A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.
- B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.
- C. Multi-conductor cables shall have the conductors color coded.

### **2.3 WIRE LUBRICATING COMPOUND**

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

### **2.4 FIREPROOFING TAPE**

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion.



It shall be arc-proof and fireproof.

- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

### **PART 3 - EXECUTION**

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

- A. Install all wiring in raceway systems.
- B. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- C. Wire Pulling:
  - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
  - 2. Use ropes made of nonmetallic material for pulling feeders.
  - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Contracting Officer Representative.
  - 4. Pull in multiple cables together in a single conduit.

#### **3.2 INSTALLATION IN MANHOLES**

- A. Install and support cables in manholes on the steel racks with porcelain or equal insulators. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.

#### **3.3 CONTROL, COMMUNICATION AND SIGNAL WIRING INSTALLATION**

- A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.

- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

#### **3.4 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION**

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

#### **3.5 EXISTING WIRING**

Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

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**SECTION 31 20 00**

**EARTHWORK**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK:**

A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:

1. Site preparation.
2. Excavation.
3. Filling and backfilling.
4. Grading.
5. Soil Disposal.
6. Clean Up.

**1.2 DEFINITIONS:**

A. Unsuitable Materials:

1. Fills: Topsoil; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, or as defined by the Soils Report.
2. Existing Subgrade: Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from design requirements, excavate to acceptable strata subject to Contracting Officer Representative's approval.

B. Trench Earthwork: Trenchwork required for utility lines.

C. Site Earthwork: Earthwork operations required within new construction area with exceptions noted above.

D. 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 D6938.

- E. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term "fill" means fill or backfill as appropriate.
- F. Backfill: Soil materials or controlled low strength material used to fill an excavation.
- G. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization by the Contracting Officer Representative. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.
- H. Authorized additional excavation: Removal of additional material authorized by the Contracting Officer Representative 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.
- I. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.
- J. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- L. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- M. 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.
- N. 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.
- O. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- P. 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.

- Q. Contaminated soils: Soil that contains contaminants as defined and determined by the Contracting Officer Representative or the Government's testing agency.

**1.3 RELATED WORK:**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**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.

**1.5 MEASUREMENT AND PAYMENT FOR EXCAVATION:**

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

**1.6 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Furnish to Contracting Office Representative:
1. 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 and AASHTO for each on site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
  - c. Test reports for compliance with ASTM D2940 requirements for subbase material.
2. Contractor shall submit procedure and location for disposal of unused satisfactory material. Proposed source of borrow material.  
Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.
3. Geotechnical engineers resume and qualifications. Geotechnical engineer shall have a CA registration.

**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):
- T99-10.....Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop
- T180-10.....Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop
- C. American Society for Testing and Materials (ASTM):
- C33-03.....Concrete Aggregate
- D448-08.....Standard Classification for Sizes of Aggregate for Road and Bridge Construction
- D698-07e1.....Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft<sup>3</sup> (600 kN m/m<sup>3</sup>))
- D1140-00.....Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
- D1556-07.....Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method

- D1557-09.....Standard Test Methods for Laboratory Compaction  
Characteristics of Soil Using Modified Effort  
(56,000 ft-lbf/ft<sup>3</sup> (2700 kN m/m<sup>3</sup>))
- D2167-08.....Standard Test Method for Density and Unit Weight  
of Soil in Place by the Rubber Balloon Method
- D2487-11.....Standard Classification of Soils for Engineering  
Purposes (Unified Soil Classification System)
- D2940-09.....Standard Specifications for Graded Aggregate  
Material for Bases or Subbases for Highways or  
Airports
- D6938-10.....Standard Test Method for In-Place Density and  
Water Content of Soil and Soil-Aggregate by  
Nuclear Methods (Shallow Depth)
- D. Society of Automotive Engineers (SAE):
- J732-07.....Specification Definitions - Loaders
- J1179-08.....Hydraulic Excavator and Backhoe Digging Forces

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS:**

- A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.
- B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups; free of rock or gravel larger than 75 mm (3 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off site sources having a minimum dry density of 1760 kg/m<sup>3</sup> (110 pcf), a maximum Plasticity Index of 15, and a maximum Liquid Limit of 40.
- C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups, or as approved by the Engineer or material with at least 90 percent passing a 37.5-mm (1 1/2-inch) sieve and not more than 12 percent passing a 75-µm (No. 200) sieve, per ASTM D2940;.
- D. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 25 mm (1 inch) sieve and not more than 8 percent passing a 75-µm (No. 200) sieve.
- E. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size

57; with 100 percent passing a 37.5 mm (1 1/2-inch) sieve and 0 to 5 percent passing a 2.36 mm (No. 8) sieve.

F. Granular Fill:

1. Under concrete slab, - granular fill shall consist of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Fine aggregate grading shall conform to ASTM C 33 with a maximum of 3 percent by weight passing ASTM D 1140.

G. Requirements for Offsite Soils: Offsite soils brought in for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCLP test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA SW-846.3-3a Method 5030/8020. TCLP shall be performed in accordance with EPA SW-846.3-3a Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site.

H. Buried Warning and Identification Tape: Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specific below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, Unaffected by moisture or soil. Warning tape color codes:

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems

I. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.076



mm (0.003 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise, and 8.6 MPa (1250 psi) crosswise, with a maximum 350 percent elongation.

J. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.102 mm (0.004 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise and 8.6 MPa (1250 psi) crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 0.9 m (3 feet) deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

K. Detection Wire For Non-Metallic Piping: Detection wire shall be Insulated single strand, solid copper with a minimum of 12 AWG.

L. Bio-treatment Soil Mix: Bioretention soils shall meet the following criteria:

1. General Requirements

Bioretention soil shall achieve a long-term, in-place infiltration rate of at least 5 inches per hour. Bioretention soil shall also support vigorous plant growth.

Bioretention soil shall be a mixture of fine sand, and compost, measured on a volume basis:

- 60% - 70% Sand
- 30% - 40% Compost

1.1 Submittals

Contractor must submit to the design engineer.

A. A sample of bioretention soil

B. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.

C. Grain size analysis results of the fine sand component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils

D. Quality analysis results for compost performed in accordance with the Seal of Testing Assurance (STA) standards, as specified in Section 1.4.

E. Organic content test results of mixed Bioretention Soil.

Organic content test shall be performed in accordance with by

Testing Methods for the Examination of Compost and Composting  
(TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".

F. Grain size analysis results of compost component performed  
in accordance with ASTM D 422, Standard Test Method for  
Particle Size Analysis of Soils.

G. A description of the equipment and methods used to mix the  
sand and compost to produce Bioretention Soil.

H. Provide the following information about the testing  
laboratory(ies) name of laboratory(ies) including:

1. Contact Person(s)
2. Address(es)
3. Phone Contact(s)
4. Email Address(es)
5. Qualifications of laboratory(ies), and personnel  
including date of current certification by STA, ASTM, or  
approved equal.

#### 1.2 Sand for Bioretention Soil

##### A. General

Sand shall be free of wood, waste, coating such as clay, stone  
dust, carbonate, etc., or any other deleterious material. All  
aggregate passing the No. 200 sieve size shall be non-plastic.

##### B. Sand for Bioretention Soil Texture

Sand for Bioretention Soils shall be analyzed by an accredited  
lab using #200, #100, #40, #30, #16, #8, #4 and 3/8 inch sieves  
(ASTM D 422 or as approved by municipality), and meet the  
following gradation:

Sieve Size	Percent Passing (by weight)	
	Min	Max
3/8 inch	100	100
No. 4	90	100
No. 8	70	100
No. 16	40	95
No. 30	15	70
No. 40	5	55
No. 100	0	15
No. 200	0	5

Note: All sands complying with ASTM C33 for fine aggregate  
comply with the above gradation requirements

#### 1.3 Composted Material

Compost shall be a well decomposed ,stable, weed free organic matter source derived from waste materials including yard debris, wood wastes or other organic materials not including manure or biosolids meeting the standards develop by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program).

A. Compost Quality Analysis

Before delivery of the soil, the supplier shall submit a copy of lab analysis performed by a laboratory that is enrolled in the US Composting Council's Compost Analysis Proficiency (CAP) program and using approved Test Methods for the Evaluation of Composting and Compost (TMECC). The lab report shall verify:

1. Feedstock Materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues.
2. Organic Matter Content: 35%-75% by dry wt.
3. Carbon and Nitrogen Ration: C:N < 25:1 and C:N > 15:1
4. Maturity/Stability: shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or is hot (120F) upon delivery or rewetting is not acceptable. In addition any one of the following is required to indicated stability:
  - a. Oxygen Test < 1.3 O<sub>2</sub>/unit TS/hr
  - b. Specific oxy. Test < 1.5 O<sub>2</sub>/unit BVS/
  - c. Respiration Test < 8 C / unit VS / day
  - d. Dewar Test < 20 Temp. rise (°C) e.
  - e. Solvita® > 5 Index value
5. Toxicity: any one of the following measures is sufficient to indicate non-toxicity.
  - a. NH<sub>4</sub>- : NO<sub>3</sub>-N < 3
  - b. Ammonium < 500 ppm, dry basis
  - c. Seed Germination > 80% of control
  - d. Plant Trials > 80% of control
  - e. Solvita® > 5 Index value
6. Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.
  - a. Total Nitrogen content 0.9% or above preferred.

b. Boron: Total shall be <80ppm; Soluble shall be <2.5ppm

7. Salinity: Must be reported; < 6.0 mmhos/cm

8. pH shall be between 6.5 and 8. May vary with plant species.

**B. Compost for Bioretention Soil Texture**

Compost for Bioretention Soils shall be analyzed by an accredited lab using #200, ¼ inch, ½ inch, and 1 inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight)	
	Min	Max
1 inch	99	100
½ inch	90	100
¼ inch	40	100
No. 200	2	10

C. Bulk Density: shall be between 500 and 1100 dry lbs/cubic yard

D. Moisture Content shall be between 30% - 55% of dry solids.

E. Inerts: compost shall be relatively free of inert ingredients, including glass, plastic and paper, < 1% by weight or volume.

F. Weed seed/pathogen destruction: provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55C for 15 days with at least 5 turnings during that period.

G. Select Pathogens: Salmonella <3 MPN/4grams of TS, or Coliform Bacteria <10000 MPN/gram.

H. Trace Contaminants Metals (Lead, Mercury, Etc) Product must meet US EPA, 40 CFR 503 regulations.

**I. Compost Testing**

The compost supplier will test all compost products within 120 calendar days prior to application. Samples will be taken using the STA sample collection protocol. (The sample collection protocol can be obtained from the US Composting Council, 4250 Veterans Memorial Highway, Suite 275, Holbrook, NY 11741; Phone: 631-737-4931; [www.compostingcouncil.org](http://www.compostingcouncil.org)). The sample shall be sent to an independent STA Program approved lab. The compost supplier will pay for the test.

M. Verification of Alternative Bioretention Soil Mixes:

Bioretention soils not meeting the above criteria may be evaluated on a case by case basis. Alternative bioretention soil must meet the following specification: "Soils for bioretention facilities must be sufficiently permeable to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility, and must provide sufficient retention of moisture and nutrients to support healthy vegetation."

The following guidance is offered to assist municipalities with verifying that alternative soil mixes meet the specification:

1. General Requirements

Bioretention soil shall achieve a long-term, in-place infiltration rate of at least 5 inches per hour. Bioretention soil shall also support vigorous plant growth.

1.1 Submittals

The applicant must submit to the municipality for approval:

- A. A sample of mixed bioretention soil.
- B. Certification from an accredited geotechnical testing laboratory that the Bioretention Soil has an infiltration rate between 5 and 12 inches per hour as tested according to Section 1.2.
- D. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method"/
- E. Grain size analysis results of mixed bioretention soil performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
- F. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.
- G. Provide the following information about the testing laboratory(ies) name of laboratory(ies) including
  - 1. Contact Person(s)
  - 2. Address(es)
  - 3. Phone Contact(s)
  - 4. Email Address(es)
  - 5. Qualifications of laboratory(ies), and personnel including date of current certification by STA, ASTM, or approved equal.

1.2 Bioretention Soil

A. General

Bioretention Soils shall be analyzed by an accredited lab using #200, and ½" inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight)	
	Min	Max
½ inch	97	100
No. 200	2	5

B. Bioretention Soil Permeability Testing

Bioretention Soils shall be analyzed by an accredited geotechnical lab for the following tests:

1. Moisture - density relationships (compaction tests) shall be conducted on bioretention soil. Bioretention soil for the permeability test shall be compacted to 85 to 90 percent of the maximum dry density (ASTM D1557).
2. Constant head permeability testing in accordance with ASTM D2434 shall be conducted on a minimum of two samples with a 6-inch mold and vacuum saturation.

**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 project site.
- B. Grubbing: Remove stumps and roots 75 mm (3 inch) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inch) diameter, and nonperishable solid objects a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left.
- C. Trees and Shrubs: Trees and shrubs, not shown for removal, shall be protected in place. Remove materials from Project Site. 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 Contracting Officer Representative. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 0.014 m<sup>3</sup> (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the soil will be destroyed.
- E. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from Project Site.
- F. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.
1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.

2. Locations of existing and proposed elevations indicated on plans, except spot elevations, are approximate. From a site survey that measured spot elevations and subsequently generated existing contours and spot elevations. 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 Contracting Officer Representative of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify Contracting Officer Representative of any differences between existing or constructed grades, as compared to those shown on the plans.
  3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.
  4. Finish grading is specified in Section 32 90 00, PLANTING.
- G. Disposal: All materials removed from the Project Site 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 Contracting Officer Representative, 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. The Contractor shall submit a Shoring and Sheet piling plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheet piling of excavations. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheet piling shall be removed as excavations are backfilled, in a manner to prevent caving.
  2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the Contracting Officer Representative.



3. Extend shoring and bracing to a minimum of 1500 mm (5 feet) below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
  4. The Contractor is required to hire a California registered Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan if necessary. A written report shall be submitted, at least monthly, informing the Contractor and Contracting Officer Representative of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Geotechnical Engineer shall be available to meet with the Contracting Officer Representative at any time throughout the contract duration.
- 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 Contracting Officer Representative. Approval by the Contracting Officer Representative is also required before placement of the permanent work on all subgrades. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 0.9 m (3 feet) of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the

dewatering system. Relieve hydrostatic head in pervious zones below subgrade elevation in layered soils to prevent uplift.

- C. 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 Contracting Officer Representative.

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. Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade of the Road with six passes of a dump truck loaded with 6 cubic meters (4 cubic yards) of soil, 13.6 meter tons (15 ton), and pneumatic-tired roller. Operate the roller truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 km/hour (2 1/2 to 3 1/2 mph). When proof rolling, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Contracting Officer Representative a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer Representative. Rutting or pumping of material shall be undercut as directed by the Contracting Officer Representative to a depth of as specified by geotechnical engineer and replaced with select fill and backfill material. Maintain subgrade until succeeding operation has been accomplished.

E. Trench Earthwork:

1. Utility trenches (except sanitary and storm sewer):
  - a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
  - b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
  - c. Support piping on suitable undisturbed earth unless a mechanical support is shown. Unstable material removed from the bottom of the

trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm (6 inches) loose thickness.

- d. Length of open trench in advance of piping laying shall not be greater than is authorized by Contracting Officer Representative.
  - e. Provide buried utility lines with utility identification tape. Bury tape 300 mm (12 inches) below finished grade; under pavements and slabs; bury tape 150 mm (6 inches) below top of subgrade
  - f. Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm (12 inches) above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m (3 feet) of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.
  - g. Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with Caltrans Standard Specifications Section 26, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:
    - 1) Class II Aggregate Base: Class II Aggregate Base shall conform to Caltrans Standard Specifications Section 26.
2. Sanitary and storm sewer trenches:
- a. Trench width shall be a minimum of 12 plus inches outside diameter of pipe and shall be 24 inches maximum for pipe up to and including 12 inches diameter, and four-thirds diameter of pipe plus 8 inches for pipes larger than 12 inches. Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.

- 1) Bed bottom quadrant of pipe on suitable undisturbed soil or granular fill. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 12 inches above top of pipe and clean earth placed and tamped by hand.
  - b. Place and compact as specified remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
  - c. Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade
  - d. Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal.
- F. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 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 Contracting Officer Representative 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 Contracting Officer Representative, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not at the contractors expense. 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.

**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 Contracting Officer Representative.
- 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 Contracting Officer Representative. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Backfill adjacent to

any and all types of structures shall be placed and compacted to at least 95 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density. 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 Caltrans Standard Specification Sections 16 & 19.
- b. Curbs, curbs and gutters, Caltrans Section 16 & 19.
- c. Under Sidewalks, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material in accordance with Caltrans Section 16 & 19.

2. Natural Ground (Cut or Existing)

- a. Under building slabs, steps and paved areas, top 6 inches, Caltrans Section 16 & 19.

D. Borrow Material: Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas shown on drawings selected by the Contractor or from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

E. Opening and Drainage of Excavation and Borrow Pits: The Contractor shall notify the Contracting Officer Representative sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of

spoil material results in minimum detrimental effects on natural environmental conditions.

### **3.5 GRADING:**

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside building away from building walls for a minimum distance of 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 Contracting Office Representative 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.

### **3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL:**

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the VA premises at contractor's own expense.
- B. Disposal: Transport surplus satisfactory soil to designated storage areas. Stockpile or spread soil as directed by Contracting Office Representative.
- 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 Contracting Officer Representative 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.

**3.7 CLEAN UP:**

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from VA Premises

----- E N D -----



**SECTION 32 05 23**  
**CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown. Construction shall include the following:
- B. Curb, gutter, and combination curb and gutter.
- C. Pedestrian Pavement: Walks, & wheelchair curb ramps.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 DESIGN REQUIREMENTS**

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

**1.4 WEATHER LIMITATIONS**

Placement of concrete shall be as specified under Article 3.8, COLD WEATHER and Article 3.7, HOT WEATHER of Section 03 30 00, CAST-IN-PLACE CONCRETE.

**1.5 SELECT SUBBASE MATERIAL JOB-MIX**

The Contractor shall retain and reimburse a testing laboratory to design a select subbase material mixture and submit a job-mix formula to the Contracting Officer Representative, in writing, for approval. The formula shall include the source of materials, gradation, plasticity index, liquid limit, and laboratory compaction curves indicating maximum density at optimum moisture.

**1.6 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.

1. Expansion joint filler
2. Hot poured sealing compound
3. Reinforcement
4. Curing materials

C. Data and Test Reports: Select subbase material.

1. Job-mix formula.
2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

#### **1.7 APPLICABLE PUBLICATIONS**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Refer to the latest edition of all referenced Standards and codes.

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

M031MM031-07-UL.....Deformed and Plain Carbon-Steel Bars for  
Concrete Reinforcement (ASTM A615/A615M-09)

M055MM055-09-UL.....Steel Welded Wire Reinforcement, Plain, for  
Concrete (ASTM A185)

M147-65-UL.....Materials for Aggregate and Soil-Aggregate  
Subbase, Base and Surface Courses (R 2004)

M148-05-UL.....Liquid Membrane-Forming Compounds for Curing  
Concrete (ASTM C309)

M171-05-UL.....Sheet Materials for Curing Concrete (ASTM C171)

M182-05-UL.....Burlap Cloth Made from Jute or Kenaf and Cotton  
Mats

M213-01-UL.....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 2.5  
kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop

T180-09-UL.....Moisture-Density Relations of Soils Using a 4.54  
kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

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

C94/C94M-09.....Ready-Mixed Concrete

C143/C143M-09.....Slump of Hydraulic Cement Concrete

## PART 2 - PRODUCTS

### 2.1 GENERAL

Concrete shall be Type C, air-entrained as specified in Section 03 30  
00, CAST-IN-PLACE CONCRETE, with the following exceptions:

<u>TYPE</u>	<u>MAXIMUM SLUMP*</u>
Curb & Gutter	75 mm (3")
Pedestrian Pavement	75 mm (3")
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

### 2.2 REINFORCEMENT

A. The type, amount, and locations of steel reinforcement shall be as shown  
on the drawings and in the specifications.

B. Welded wire-fabric shall conform to AASHTO M55.

- C. Dowels shall be plain steel bars conforming to AASHTO M31. Tie bars shall be deformed steel bars conforming to AASHTO M31.

### **2.3 SELECT SUBBASE (WHERE REQUIRED)**

- A. Subbase material shall conform to Section 31 20 00 "Earthwork" and as shown on the Drawings.
- B. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified in these specifications and drawings.

### **2.4 FORMS**

- A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.
- B. Do not use forms if they vary from a straight line more than 3 mm (1/8 inch) in any 3000 mm (ten foot) long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 50 mm (2 inches) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

### **2.5 CONCRETE CURING MATERIALS**

- A. Concrete curing materials shall conform to one of the following:
  - 1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry.
  - 2. Impervious Sheeting conforming to AASHTO M171.
  - 3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), and shall be free of paraffin or petroleum.

### **2.6 EXPANSION JOINT FILLERS**

Material shall conform to AASHTO M213.

### **2.7 COLORED CONCRETE**

The amount of pigment used to achieve integral colored concrete should be the minimum amount necessary to produce the desired color, but never

more than 10 percent by weight of the cement. Use white Portland cement as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, Architectural Concrete.

- A. Integral Color Concrete: pedestrian pavement designed to be colored shall have the coloring introduced into the concrete mix at the batch plant. Introduce sufficient quantities of, carbon black, mineral oxide pigment, to produce the color specified. Prior to starting work, submit a sample of the colored concrete with type of coloring additive and the amount of additive per cubic yard of concrete mix to the Contracting Officer's Representative for approval. Color and mixtures used should not produce a concrete having less than the desired air content specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- B. Types: Walkways and ramps shall be colored and finished as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Samples:

Concrete panel, 5 square feet by full side walk thick, each color and finish.

### **PART 3 - EXECUTION**

#### **3.1 SUBGRADE PENETRATION**

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTH MOVING.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

#### **3.2 SELECT SUBBASE (WHERE REQUIRED)**

- A. Mixing: Proportion the select subbase by weight or by volume in quantities so that the final approved job-mixed formula gradation, liquid limit, and plasticity index requirements will be met after subbase course has been placed and compacted. Add water in approved quantities, measured by weight or volume, in such a manner to produce a uniform blend.

B. Placing:

1. Place the mixed material on the prepared subgrade in a uniform layer to the required contour and grades, and to a loose depth not to exceed 200 mm (8 inches), and that when compacted, will produce a layer of the designated thickness.
2. When the designated compacted thickness exceeds 150 mm (6 inches), place the material in layers of equal thickness. Remove unsatisfactory areas and replace with satisfactory mixture, or mix the material in the area.
3. In no case will the addition of thin layers of material be added to the top layer in order to meet grade.
4. If the elevation of the top layer is 13 mm (1/2 inch) or more below the grade, excavate the top layer and replace with new material to a depth of at least 75 mm (3 inches) in compacted thickness.

C. Compaction:

1. Perform compaction with approved equipment (hand or mechanical) well suited to the material being compacted.
2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
3. Compact each layer to at least 95 percent or 100 percent of maximum density as determined by AASHTO T180 or AASHTO T99 respectively.

D. Smoothness Test and Thickness Control:

Test the completed subbase for grade and cross section with a straight edge.

1. The surface of each layer shall not show any deviations in excess of 10 mm (3/8 inch).
2. The completed thickness shall be within 13 mm (1/2 inch) of the thickness as shown.

E. Protection:

1. Maintain the finished subbase in a smooth and compacted condition until the concrete has been placed.
2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted subbase, excavate, and reconstruct it with new material meeting the requirements herein specified, at no additional cost to the VA.

### **3.3 SETTING FORMS**

#### **A. Base Support:**

1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.

#### **B. Form Setting:**

1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
3. Forms shall conform to line and grade with an allowable tolerance of 3 mm (1/8 inch) when checked with a straightedge and shall not deviate from true line by more than 6 mm (1/4 inch) at any point.
4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
5. Clean and oil forms each time they are used.

- C. The Contractor's Registered Professional Land Surveyor, specified in Section 01 00 00, GENERAL REQUIREMENTS, 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 Contracting Officer's Representative 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 Contracting Officer's Representative 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 Contracting Officer's Representative before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the Contracting Officer Representative before placing concrete.
- C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.
- E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets.



Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.

- F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.
- G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

### **3.7 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS**

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

### **3.8 PLACING CONCRETE FOR VEHICULAR PAVEMENT**

- A. Deposit concrete into the forms as close as possible to its final position.
- B. Place concrete rapidly and continuously between construction joints.
- C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.
- D. Finish the surface to the elevation and crown as shown.

- E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes without approval by the Contracting Officer Representative.

### **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, Wheelchair Curb Ramps:**

1. Finish the surfaces to grade and cross section with a metal float, trowled smooth and finished with a broom moistened with clear water.
2. Brooming shall be transverse to the line of traffic.
3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 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 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.

### **3.13 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.

### **3.14 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.

### **3.15 CONSTRUCTION JOINTS**

- A. Locate longitudinal and transverse construction joints between slabs 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.

### **3.16 FORM REMOVAL**

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

### **3.17 CURING OF CONCRETE**

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

3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

### **3.18 CLEANING**

#### **A. After completion of the curing period:**

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

### **3.19 PROTECTION**

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

### **3.20 FINAL CLEAN-UP**

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

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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. A. This Section includes specifications for constructing new asphalt concrete wearing surface Type A, 1/2-inch maximum with medium grading.

**1.2 RELATED WORK**

A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 INSPECTION OF PLANT AND EQUIPMENT**

The Contracting Officer Representative 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.

**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 Section 39 of CTSS.
2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by Section 39 of CTSS.
3. Job-mix formula.

C. Certifications:

1. Asphalt prime and tack coat material certificate of conformance to Section 39 of CTSS requirements.
2. Asphalt cement certificate of conformance to CTSS requirements.
3. Job-mix certification - Submit plant mix certification that mix equals or exceeds Section 39 of CTSS.
4. Prior to starting construction, the Contractor shall submit the asphalt concrete mix design including the amount of asphalt binder to be mixed with the dry aggregate to the Engineer for approval. No resurfacing work will be allowed prior to the approval of the mix design. Asphalt concrete mix design shall conform to Section 39 of CTSS.
5. The Contractor shall submit (8) copies of manufacturer's literature, specifications, applications and installations for filler and/or sealer material to the Engineer for approval at least five (5) calendar days in advance of performing the filling and/or sealing work.

**PART 2 - PRODUCTS AND EQUIPMENT**

**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 Section 39 of CTSS, including amendments, addenda and errata. Where the term "Engineer" is referenced in Section 39 of CTSS, it shall mean the Contracting Officers Representative

**2.2 MATERIALS**

- A. Asphalt: In accordance with the requirements of Section 39-2.01 of CTSS, except that asphalt shall be either PG 64-10 or AR-4000.
- B. Aggregate: In accordance with the requirements of Section 39-2.02 of CTSS, except that aggregate grading shall be as follows:



Sieve Sizes	Limits of		
	Proposed Gradation	Operating Range	Contract Compliance
3/4"	-----	100	100
1/2"	-----	95-100	89-100
3/8"	-----	80-95	75-100
No. 4	59-66	X <sup>±</sup> 5	X <sup>±</sup> 8
No. 8	43-49	X <sup>±</sup> 5	X <sup>±</sup> 8
No. 30	22-27	X <sup>±</sup> 5	X <sup>±</sup> 8
No. 200	-----	3-8	0-11

Minimum Durability Index: When tested in accordance with Caltrans  
Test Method 229, shall be 50.

c. Tack coat in accordance with Section 39 of CTSS.

## 2.02 EQUIPMENT

A. Spreading Equipment: In accordance with the requirements of Section  
39 of CTSS.

B. Compacting Equipment: In accordance with the requirements of Section  
9 of CTSS.

## 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 Section 39 of CTSS for the type of material specified.

### 3.2 MIXING ASPHALTIC CONCRETE MATERIALS

A. Provide hot plant-mixed asphaltic concrete paving materials.

1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum,  
160 degrees C(320 degrees F) maximum.

2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

### 3.3 SUBGRADE

A. Shape to line and grade and compact with self-propelled rollers.

B. All depressions that develop under rolling shall be filled with  
acceptable material and the area re-rolled.

- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 50 ton gross weight dump truck as directed by Contracting Officers Representative. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

### **3.4 BASE COURSES**

- A. Base
  - 1. Spread and compact to the thickness shown on the drawings.
  - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
  - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).
- E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

### **3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING**

- A. Remove all loose materials from the compacted base.
- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Contracting Officers Representative.
- C. Receipt of asphaltic concrete materials:
  - 1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C (280 degrees F).
  - 2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.
- D. Spreading:
  - 1. Spread material in a manner that requires the least handling.
  - 2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.
- E. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
  - a. No depressions which will retain standing water.
  - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

### **3.6 APPLICATION OF SEAL COAT**

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

### **3.7 PROTECTION**

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

### **3.8 FINAL CLEAN-UP**

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

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**SECTION 32 17 13**

**WHEEL STOPS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Section includes specifications for precast concrete wheel stops for vehicular parking stalls in parking structures and parking lots as indicated.

**1.2 REFERENCE STANDARDS**

- A. State of California, Department of Transportation Caltrans, Standard Specifications.

**1.3 SUBMITTALS**

- A. Product Data: Submit manufacturers' product data of precast stops and epoxy adhesive for approval.

**1.4 QUALITY ASSURANCE:**

- A. Precast wheel stops shall be manufactured for the intended purpose by a company or firm specializing in the manufacture of precast concrete parking appurtenances.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Wheel Stops: Precast, 3.5% minimum air-entrained concrete; 4000 psi minimum compressive strength. Each stop shall be reinforced with two No. 4 deformed steel reinforcing bars, minimum. Provide chamfered corners and drainage slots on underside, and provide holes for dowel-anchoring to substrate. Unless indicated otherwise, provide stops of half octagonal configuration and 30 inch length.
- B. Adhesive for Anchoring Stops to Parking Structure Slabs, At-Grade Concrete Pavements, and At-Grade Asphalt Pavements: Epoxy adhesive manufactured for the purpose, similar and equal to the adhesives specified in Caltrans Standard Specifications, Section 95-2.04 or 95-2.05.
- C. Adhesive for Bonding Dowel to Wheel Stop: As proposed by Contractor and approved by the Engineer, suitable for application.

- D. Steel Bars for Installation: Galvanized 5/8" diameter steel dowels or galvanized

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Securely attach wheel stops into at-grade concrete and at-grade asphalt pavement with not less than two galvanized steel dowels embedded in holes cast into wheel stops. Firmly bond each dowel to wheel stop and to pavement.
- B. At concrete pavement, drill holes in pavement for dowels.
- C. At parking structure slabs, epoxy to slab.

- - - E N D - - -

**SECTION 32 17 23**  
**PAVEMENT MARKINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This work shall consist of furnishing and applying paint and reflective glass beads on pavement surfaces, in the form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings, in accordance with the details as shown or as prescribed by the Contracting Office Representative. Conform to the Manual on Uniform Traffic Control Devices for Streets and Highways, published by the U.S. Department of Transportation, Federal Highway Administration, for details not shown.

**1.2 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish Manufacturer's Certificates and Data certifying that the following materials conform to the requirements specified.
- B. Paint.
- C. Reflective Glass Beads

**1.3 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
  - TT-B-1325C.....Beads (Glass Spheres); Retro-Reflective
  - TT-P-1952E.....Paint, Traffic Black, and Airfield Marking,  
Waterborne
- C. Master Painters Institute (MPI):
  - Approved Product List - 2010

**PART 2 - PRODUCTS**

**2.1 PAINT**

Paint for marking pavement (parking lot and zone marking) shall conform to MPI No. 97, color per campus and Federal Standards. Paint for obliterating existing markings shall conform to Fed. Spec. TT-P-1952E. Paint shall be in containers of at least 18 L (5 gallons). A certificate

shall accompany each batch of paint stating compliance with the applicable publication.

## **2.2 REFLECTIVE GLASS BEADS**

Beads shall conform to Fed. Spec. TT-B-1325C, Type II, Gradation A. When used in regions of high humidity, coat beads with silicone or other suitable waterproofing material to assure free flow. Furnish the glass beads in containers suitable for handling and strong enough to prevent loss during shipment. A certificate shall accompany each batch of beads stating compliance with this section.

## **2.3 PAINT APPLICATOR**

Apply all marking by approved mechanical equipment. The equipment shall provide constant agitation of paint and travel at controlled speeds. Synchronize one or more paint "guns" to automatically begin and cut off paint flow in the case of skip lines. The equipment shall have manual control to apply continuous lines of varying length and marking widths as shown. Provide pneumatic spray guns for hand application of paint in areas where a mobile paint applicator cannot be used. If the equipment does not have a glass bead dispenser, use a separate piece of equipment.

Adjust and synchronize the equipment with the paint applicator so that the reflective beads are distributed uniformly on the paint lines within ten seconds without any waste. An experienced technician that is thoroughly familiar with equipment, materials, and marking layouts shall control all painting equipment and operations.

## **2.4 SANDBLASTING EQUIPMENT**

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall furnish not less than 0.08 m<sup>3</sup>/s (150 cfm) of air at a pressure of not less than 625 kPa (90 psi) at each nozzle used.

# **PART 3 - EXECUTION**

## **3.1 SURFACE PREPARATION**

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Completely remove rubber deposits, existing paint



markings, and other coatings adhering to the pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by the Contracting Officer Representative. The application of paint conforming to Fed. Spec. TT-P-1952D is an option to removal of existing paint markings on asphalt pavement. Apply the black paint in as many coats as necessary to completely obliterate the existing markings. Where oil or grease are present on old pavements to be marked, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint. Pavement marking shall follow as closely as practicable after the surface has been cleaned and dried, but do not begin any marking until the Contracting Office Representative has inspected the surface and gives permission to proceed. The Contractor shall establish control points for marking and provide templates to control paint application by type and color at necessary intervals. The Contractor is responsible to preserve and apply marking in conformance with the established control points.

### **3.2 APPLICATION**

Apply uniformly painted and reflective pavement marking of required color(s), length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces in conformance with the details as shown and established control points. The length and width of lines shall conform within a tolerance of plus or minus 75 mm (3 inches) and plus or minus 3 mm (1/8 inch), respectively, in the case of skip markings. The length of intervals shall not exceed the line length tolerance. Temperature of the surface to be painted and the atmosphere shall be above 10°C (50°F) and less than 35°C (95°F). Apply the paint at a wet film thickness of 0.4 mm (0.015 inch). Disperse reflective glass beads evenly on the wet paint at a rate of 720 g/L (6 pounds per gallon) of paint. Apply paint in one coat. At the direction of the Contracting Officer Representative, markings showing light spots may receive additional coats. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the marking, discontinue paint operations until cause of the slow drying is determined and corrected. Remove and replace marking that is applied at less than minimum material rates; deviates from true alignment; exceeds stipulated

length and width tolerances; or shows light spots, faulty distribution of beads, smears, or other deficiencies or irregularities. Use carefully controlled sand blasting, approved grinding equipment, or other approved method to remove marking so that the surface to which the marking was applied will not be damaged.

### **3.3 PROTECTION**

Conduct operations in such a manner that necessary traffic can move without hindrance. Protect the newly painted markings so that, insofar as possible, the tires of passing vehicles will not pick up paint. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic. Efface and replace damaged portions of markings at no additional cost to the Government.

### **3.4 DETAIL PAVEMENT MARKING**

Use Detail Pavement Markings, exclusive of actual traffic lane marking, at exit and entrance islands and turnouts, on curbs, at crosswalks, at parking bays, and at such other locations as shown. Show the International Handicapped Symbol at indicated parking spaces. Color shall be as shown. Apply paint for the symbol using a suitable template that will provide a pavement marking with true, sharp edges and ends. Place detail pavement markings of the color(s), width(s) and length(s), and design pattern at the locations shown.

### **3.5 TEMPORARY PAVEMENT MARKING**

When shown or directed by the Contracting Office Representative, apply Temporary Pavement Markings of the color(s), width(s) and length(s) shown or directed. After the temporary marking has served its purpose and when so ordered by the Contracting Officer Representative, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that the surface to which the marking was applied will not be damaged. As an option, an approved preformed pressure sensitive, reflective, adhesive tape type of temporary pavement marking of the required color(s), width(s) and length(s) may be furnished and used in lieu of temporary painted and reflective marking. The Contractor shall be fully responsible for the continued durability and effectiveness of such marking during the period for which its use is required. Remove any unsatisfactory tape type

marking and replace with painted and reflective markings at no  
additional cost to the Government.

### **3.6 FINAL CLEAN-UP**

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

- - - E N D - - -



**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 existing water supply mains. Main water supply lateral connected to existing main to new Fisher House, valved-off for connection by a separate contract to the Fisher House. New Fire Hydrant, PIV and associated controls at Loop Road.

**1.2 RELATED WORK:**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**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, 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 Representative for approval.)
1. Piping.
  2. Gaskets.
  3. Valves.
  4. Fire hydrants.
  5. Vaults, frames and covers.
  6. Valve boxes.
  7. Joint restraint.
  8. Disinfection products.
- 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
- C. American Society for Testing and Materials (ASTM):
- A536-04.....Standard Specifications for Ductile Iron Castings
- D1784-03.....Standard Specifications for Rigid PVC Compounds and CPVC Compounds
- 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
- D. American Water Works Association (AWWA):
- B300-04.....Hypochlorites
- B301-04.....Liquid Chlorine
- C104-04.....Cement Mortar Lining for Ductile Iron Pipe and  
Fittings for Water
- C105-99.....Polyethylene Encasement for Gray and Ductile  
C.I. Piping for Water and Other Liquids
- C110-03.....Ductile-Iron and Gray-Iron Fittings, 80 mm (3  
Inches) Through 1200 mm (48 Inches) for Water  
and Other Liquids
- C111-01.....Rubber-Gasket Joints for Ductile-Iron and  
Gray-Iron Pressure Pipe and Fittings
- C115-99.....Flanged Ductile-Iron and Gray-Iron Pipe with  
Threaded Flanges
- C150-02.....American National Standard for Thickness Design  
of Ductile Iron Pipe
- C151-96.....Ductile-Iron Pipe, Centrifugally Cast in Metal  
Molds or Sand-Lined Molds, for Water or Other  
Liquids
- C153-00.....Ductile-Iron Compact Fittings, 80 mm (3 inches)  
Through 300 mm (12 Inches) for Water and Other  
Liquids
- C500-02.....Gate Valves for Water and Sewerage Systems
- C503-97.....Wet-Barrel Fire Hydrants
- C509-01.....Resilient Seated Gate Valve for Water System
- 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

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)

**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, minimum 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 push-on joints, mechanical joint or approved restrained joint. Provide flange joint pipe where shown on the drawings. Provide mechanical and restrained joint pipe with sufficient quantities of accessories as required for each joint.
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, 850 kPa (125 psi) or 1725 kPa (250 psi) standard, for the purpose intended.



2. Pipe Thickness Class: Minimum of Class 53 as defined in AWWA C150 for all sizes of flanged pipe.
3. Rubber Ring Gaskets: Full face type, AWWA C111, 1/16 inch rubber ring gaskets and of approved composition suitable for the required service.
4. 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 2400 kPa (350 psi). Fittings shall meet the requirements of ANSI and AWWA specifications as applicable. Rubber gasket joints shall conform to AWWA C111 for mechanical and push-on type joints. Ball joints shall conform to AWWA C151 with a separately cast ductile iron bell conforming to ASTM A148. Flanged fittings shall conform to AWWA C115 and be furnished flat faced and drilled to 850 kPa (125 psi) or 1725 kPa (250 psi) template in accordance with ANSI B16.1 with full faced gaskets.
- D. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior.
- E. Provide a factory hydrostatic test of not less than 3.5 MPa (500 psi) for all pipe in accordance with AWWA C151.
- F. Provide non-detectable adhesive backed identification tape on top and sides of all buried ductile iron pipe, extended from joint to joint along the length of the pipe and have black lettering identifying the pipe service at no more than 12 inch intervals. According to service, the tape background color shall be as follows: force main/sanitary-green; potable water-blue; reclaimed water-lavender.

## **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 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, 1375 kPa (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: Furnish valves with 2 inch nut for socket wrench operation. Valves shall comply with the requirements of NFPA 24.
3. Joints: Ends of valves shall accommodate, or be adapted to, pipe installed.

**2.4 VALVE BOX:**

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 [ ] "T" handle socket wrenches of 5/8 inch round stock long enough to extend 2 feet above top of deepest valve box.

**2.5 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.

**2.6 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.
- 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.
  3. Provide PIV at hydrant and associated control wiring.

**2.7 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".

**2.8 POTABLE WATER:**

Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

**2.9 DISINFECTION CHLORINE:**

- A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.
- B. Sodium hypochlorite shall conform to AWWA B300 with 5 percent to 15 percent available chlorine.

- C. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5.g tablets, and shall contain 65 percent chlorine by weight.

#### **2.19 WARNING TAPE**

Standard, 4-Mil polyethylene 3 inch wide tape, detectable type, blue with black letters, and imprinted with "CAUTION BURIED WATER LINE BELOW".

### **PART 3 - EXECUTION**

#### **3.1 REGRADING:**

Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.

#### **3.2 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 Contracting Officer Representative.
- 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.

### **3.3 DUCTILE IRON PIPE:**

- A. Installing Pipe: Lay pipe in accordance with AWWA C600 with polyethylene encasement if required in accordance with AWWA C105. Provide a firm even bearing throughout the length of the pipe by tamping selected material at the sides of the pipe up to the spring line.
- B. All pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Cement lining shall be undamaged.
- D. Jointing Ductile-Iron Pipe:
  - 1. Push-on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe is to be aligned with the bell of the pipe to which it is joined, and pushed home with approved means.
  - 2. Mechanical Joints at Valves, Fittings: Install in strict accordance with AWWA C111. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gaskets with soapy water before tightening the bolts. Bolts shall be tightened to the specified torque.
  - 3. Ball Joints: Install in strict accordance with the manufacturer's instructions. Where ball joint assemblies occur at the face of

structures, the socket end shall be at the structure and ball end assembled to the socket.

4. Flanged joints shall be in accordance with AWWA C115. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

### **3.4 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 2.3 kg (5 pound) magnesium anode attached to the main tracer wire by solder. The solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall be attached at the end of each line.
- C. Magnetic markers may be used in lieu of copper tracer wire to aid in future pipe locating. Generally, install markers on 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.

### **3.5 RESTRAINED JOINTS:**

- A. Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained "locked-type" joints and the joints shall be capable of holding against withdrawal for line pressures 50 percent above the normal working pressure but not less than 1375 kPa (200 psi). The pipe and fittings shall be restrained push-on joints or restrained mechanical joints.
- B. The minimum number of restrained joints required for resisting force at fittings and changes in direction of pipe shall be determined from the length of retained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. Restrained pipe length shall be as shown on the drawings.
- C. Restrained joint assemblies with ductile iron mechanical joint pipe shall be "Flex-Ring", "Lok-Ring", or mechanical joint coupled as

manufactured by American Cast Iron Pipe Company, "Mega-Lug" or approved equal.

- D. Ductile iron pipe bell and spigot joints shall be restrained with EBBA Iron Sales, Inc. Series 800 Coverall or approved equal.
- E. Ductile iron mechanical joint fittings shall be restrained with EBBA Iron Sales, Inc. Series 1200 Restrainer. The restraining device shall be designed to fit standard mechanical joint bells with standard T head bolts conforming to AWWA C111 and AWWA C153. Glands shall be manufactured of ductile iron conforming to ASTM A536. Set screws shall be hardened ductile iron and require the same torque in all sizes. Steel set screws not permitted. These devices shall have the stated pressure rating with a minimum safety factor of 2:1. Glands shall be listed with Underwriters Laboratories and/or approved by Factory Mutual.
- F. Thrust blocks shall not be permitted.
- G. Where ductile iron pipe manufactured with restrained joints is utilized, all restrained joints shall be fully extended and engaged prior to back filling the trench and pressurizing the pipe.
- H. PVC pipe bell and spigot joints shall be restrained with the Uni-Flange Corp. Series 1350 Restrainer or approved equal. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.
- I. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained with UNI-Flange Corp. Series 1300 Restrainer, EBBA Iron, Inc, Series 2000PV Mechanical Joint Restrainer Gland, or approved equal. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A-536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.

### **3.6 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.

### **3.7 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.

### **3.8 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.

### 3.9 FLUSHING AND DISINFECTING:

- A. Flush and disinfect new and existing disturbed water lines in accordance with AWWA C651. Test before operation.
- B. Initial flushing shall obtain a minimum velocity in the main of 0.75 m/sec (2.5 feet per second) at 40 PSI residual pressure in water main. The duration of the flushing shall be adequate to remove all particles from the line.

Pipe Diameter		Flow Required to Produce 2.5 ft/sec(approx.) Velocity in Main		Number of Hydrant Outlets			
				Size of Tap. in. (mm)			
				1(25)	1 ½(38)	2(51)	2 1/2-in (64 mm)
In	(mm)	gpm	(L/sec)	Number of taps on pipe			
4	(100)	100	(6.3)	1	--	--	1
6	(150)	200	(12.6)	--	1	--	1
8	(200)	400	(25.2)	--	2	1	1
10	(250)	600	(37.9)	--	3	2	1
12	(300)	900	(56.8)	--	--	3	2
16	(400)	1,600	(100.9)	--	--	4	2

The backflow preventers shall not be in place during the flushing.

- C. The Contractor shall be responsible to provide the water source for filling, flushing, disinfecting and testing the lines. Only potable water shall be used, and the Contractor shall provide all required temporary pumps, storage facilities required to complete the specified flushing, and disinfection operations.
- D. The Contractor shall be responsible for the disposal of all water used to flush and disinfect the system in accordance with all governing rules

and regulations. The discharge water shall not be allowed to create a nuisance for activities occurring on or adjacent to the site.

- E. The bacteriological test specified in AWWA C651 shall be performed by a laboratory approved by the Health Department, Department of Environmental Quality of the State. The cost of sampling, transportation, and testing shall be the responsibility of the Contractor.
- F. Re-disinfection and bacteriological testing of failed sections of the system shall be the sole responsibility of the Contractor.
- G. Before backflow preventers are installed, all upstream piping shall be thoroughly flushed.

**3.10 HYDROSTATIC TESTING:**

- A. Hydrostatic testing of the system shall occur prior to disinfecting the system.
- B. After new system is installed, except for connections to existing system and building, backfill at least 300 mm (12 inches) above pipe barrel, leaving joints exposed. The depth of the backfill shall be adequate to prevent the horizontal and vertical movement of the pipe during testing.
- C. Prior to pressurizing the line, all joint restraints shall be completely installed and inspected.
- D. If the system is tested in sections, and at the temporary caps at connections to the existing system and buildings, the Contractor shall provide and install all required temporary thrust restraints required to safely conduct the test.
- E. The Contractor shall install corporation stops in the line as required to purge the air out of the system. At the completion of the test, all corporation stops shall be capped.
- F. The Contractor shall perform pressure and leakage tests for the new system for 2 hours to 1375 kPa (200 psi). Leakage shall not exceed the following requirements.
  - 1. Copper Tubing: No leaks.
  - 2. Ductile Iron Pipe: AWWA C600. Provide to Contracting Officer Representative office.
  - 3. Polyvinyl Chloride (PVC) AWWA C605. Provide to Contracting Officer Representative office.

- - - E N D - - -

**SECTION 33 30 00**  
**SANITARY SEWER UTILITIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. Outside, underground sanitary sewer system, complete, ready for operation, including gravity flow lines, manholes, cleanouts, frames, covers, structures, appurtenances, and connections to new building and structure, service lines, existing sanitary sewer lines, and existing sanitary structures, and all other incidentals.

**1.2 RELATED WORK:**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 QUALITY ASSURANCE:**

- A. Products Criteria:
  - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
  - 2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, including model number, securely affixed in a conspicuous place on equipment, or name or trademark, including model number cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

**1.4 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data: Submit the following as one package:
  - 1. Pipe, Fittings, and, Appurtenances.
  - 2. Jointing Material.
  - 3. Manhole and Structure Material.
  - 4. Frames and Covers.

5. Steps and Ladders.
6. Gate Valves.
7. Valve Boxes.
8. Check Valves.

**1.5 APPLICABLE PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - A48/A48M-03.....Gray Iron Castings
  - A536-84(2004).....Ductile Iron Castings
  - A615/A615M-06.....Deformed and Plain Carbon-Steel Bars for  
Concrete Reinforcement
  - A625/A625M-03.....Tin Mill Products, Black Plate, Single Reduced
  - A746-03.....Ductile Iron Gravity Sewer Pipe
  - C12-06.....Installing Vitrified Clay Pipe Lines
  - C76-05b/C76M-05b.....Reinforced Concrete Culvert, Storm Drain and  
Sewer Pipe
  - C150-05.....Portland Cement
  - C425-04.....Compression Joints for Vitrified Clay Pipe and  
Fittings
  - C478-06a/C478M-06a.....Precast Reinforced Concrete Manhole Sections
  - C700-05.....Vitrified Clay Pipe, Extra Strength, Standard  
Strength, and Perforated
  - C828-03.....Low-Pressure Air Test of Vitrified Clay Pipe  
Lines
  - C857-95(2001).....Minimum Structural Design Loading for  
Underground Precast Concrete Utility Structures
  - D698-00a1.....Laboratory Compaction Characteristics of Soil  
Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600  
kN-m/m<sup>3</sup>))

- D2321-05.....Underground Installation of Thermoplastic Pipes  
for Sewers and Other Gravity-Flow Applications
- D2412-02.....Determination of External Loading  
Characteristics of Plastic Pipe by Parallel-  
Plate Loading
- D2992-01.....Practice for Obtaining Hydrostatic or Pressure  
Design Basis for Fiberglass (Glass-Fiber-  
Reinforced Thermosetting-Resin) Pipe and  
Fittings
- D3034-04a.....Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe  
and Fittings
- D3212-96a (2003) e1.....Joints for Drain and Sewer Plastic Pipes Using  
Flexible Elastomeric Seals
- D3261-03.....Butt Heat Fusion Polyethylene (PE) Plastic  
Fittings for Polyethylene (PE) Plastic Pipe and  
Tubing
- D3350-05.....Polyethylene Plastics Pipe and Fittings  
Materials
- D4101-05a.....Polypropylene Injection and Extrusion Materials
- F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic  
Pipe
- F679-06.....Poly (vinyl chloride) (PVC) Large-Diameter  
Plastic Gravity Sewer Pipe and Fittings
- F714-05.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based  
on Outside Diameter
- F794-03.....Poly (Vinyl Chloride)(PVC) Ribbed Gravity Sewer  
Pipe and Fittings Based on Controlled Inside  
Diameter
- F894-05.....Polyethylene (PE) Large Diameter Profile Wall  
Sewer and Drain Pipe
- F949-03.....Poly (Vinyl Chloride) (PVC) Corrugated Sewer  
Pipe with Smooth Interior and Fittings

C. American Water Works Association (AWWA):

C105/A21.5-05.....	Polyethylene Encasement for Ductile Iron Pipe Systems
C110/A21.10-03.....	Ductile-Iron and Gray-Iron Fittings for Water
C111/A21.11-00.....	Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
C115-99.....	Flanged Ductile-Iron Pipe with Threaded Flanges
C116-03.....	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron Pipe and Gray Iron Fittings for Water Supply Service
C151-/A21.51-02	Ductile-Iron Pipe, Centrifugally Cast for Water
C153-00	Ductile-Iron Compact Fittings for Water Services
C508-01.....	Swing Check Valves for Waterworks, 2 inches (50 mm) Through 24 inches (600 mm) NPS
C509-01.....	Resilient Seated Gate Valves for Water-Supply Service
C515-01.....	Reduced-Wall, Resilient-Seated Gate Valves For Water Supply Service
C512-04.....	Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
C550-05.....	Protective Epoxy Interior Coatings for Valves and Hydrants
C600-05.....	Installation for Ductile-Iron Water Mains and Their Appurtenances
C605-94.....	Underground Installation of Polyvinyl (PVC) Pressure Pipe and Fittings for Water
C900-97 .....	Polyvinyl Chloride (PVC) Pressure Pipe, 100 mm (4 inches) Through 300 mm (12 inches) for Water Distribution

C905-97.....Polyvinyl Chloride (PVC) Pressure Pipe and  
Fabricated Fittings, 350 mm through 1,200 mm  
(14 Inches through 48 Inches), for Water  
Transmission and Distribution

C906-99.....Polyethylene (PE) Pressure Pipes and Fittings,  
100 mm through 1575 mm (4 Inches through 63  
Inches), for Water Distribution

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

M198-05.....Joints for Concrete Pipe, Manholes, and Precast  
Box Sections using Preformed Flexible Joint  
Sealants

E. Uni-Bell PVC Pipe Association:

Uni-B-6-98.....Recommended Practice Low Pressure Air Testing  
of Installed Sewer Pipe

## **PART 2 - PRODUCTS**

### **2.1 PIPING:**

A. Gravity Flow Lines (Pipe and Fittings):

1. Polyvinyl Chloride (PVC):

a. Pipe and Fittings, 100 to 375 mm (4 to 15 inches) in diameter,  
shall conform to ASTM D3034. Pipe and fittings shall have  
elastomeric gasket joints providing a watertight seal when tested  
in accordance with ASTM D3212. Gaskets shall conform to ASTM  
F477. Solvent welded joints shall not be permitted.

b. Pipe and fittings, 450 to 900 mm (18 to 36 inches) in diameter,  
shall be solid wall or have a corrugated or ribbed exterior  
profile and a smooth interior. Pipe shall conform to the  
following:

1) Pipe and fittings shall conform to ASTM F949 corrugated sewer  
pipe with a smooth interior. The corrugated outer wall shall  
be fused to the smooth interwall at the corrugation valley.  
Pipe and fitting shall have a smooth bell, elastomeric joints  
conforming to ASTM D3212, and shall have a minimum pipe

stiffness of 350 kPa (50 psi) at 5 percent deflection, when tested in accordance with ASTM D2412. Corrugation shall be perpendicular to the axis of the pipe to allow gaskets to be installed on field cut sections of pipe without the requirement for special fittings.

2) Ribbed wall PVC pipe and fittings shall conform to ASTM F794 ribbed sewer pipe with smooth interior pipe and fittings shall have a smooth bell, elastomeric joints conforming to ASTM D3212, and shall have a minimum pipe stiffness of 320 kPa (46 psi) when tested in accordance with ASTM D 2412, at 5 percent vertical deflection. Joints shall not leak at 7.6 m (25 feet) of head under 5 percent deflection.

3) Solid wall pipe and fittings shall conform to ASTM F679, pipe and fittings shall gaskets conforming to ASTM F477, and shall be able to withstand a hydrostatic pressure of 345 kPa (50 psi).

2. Ductile Iron Pipe (DIP) for Sanitary Sewer: Shall conform to ASTM A746, thickness Class 51 unless otherwise shown or specified. Joints on pipe and fittings shall be push-on style and conform to AWWA C110 and AWWA C111, rated for 1.03 MPa (150 psi). Exterior coating shall be approximately 0.025 mm (1 mil) asphaltic coating as specified in ASTM A746. Interior lining shall be a catalyzed coal tar epoxy, having a minimum thickness of 0.60 mm (24 mils), a permeability rating of 0.13 perms, direct impact rating of 11.3 Nm (100 in-lbs), an abrasion resistance of 20 liters of sand per mil, and dielectric strength of 250 volts per mil. Pipe and fittings shall be polyethylene encased with 0.20 mm (8 mil) polyethylene sheeting per AWWA C105. Color of polyethylene encasement shall be green.

3. High density polyethylene (HDPE) pipe and fittings 450 mm to 900 mm (18 inches to 36 inches) shall conform to ASTM F894. Pipe and fittings shall have a smooth interwall and profile exterior, and be Class 100. Joints shall be water tight elastomeric gaskets in accordance with ASTM D3212, or thermal welded joints.

## **2.2 JOINTING MATERIAL:**

### **A. Gravity Flow Lines:**

1. Vitrified Clay Pipe: Rubber gasket, ASTM C425.



2. Ductile Iron Pipe: Push-on or mechanical joints, AWWA C111, AWWA C110. Flange joints shall comply with AWWA C115. Flange joints shall only be used in vaults or above-grade.
  3. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212. Elastomeric gasket, ASTM F477.
  4. High Density Polyethylene (HDPE) pipe and fitting joints, ASTM E-3212, elastomeric gaskets, ASTM F477.
- B. Gravity Flow with Secondary Containment: Tapered or straight bell and spigot with adhesive bond. Completed joint shall be equal or greater than the pressure rating of the pipe.

### **2.3 MANHOLES:**

- A. Manholes shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. The manholes and vaults shall be in accordance with State Department of Transportation or State Roads Commission standard details, and the following:
1. Precast Concrete Segmental Blocks: Blocks shall conform to ASTM C139 and shall not be less than 150 mm (6 inches) thick for manholes to a depth of 3.6m (12 feet); not less than 200 mm (8 inches) thick for manholes deeper than 3.6m (12 feet) deep. Blocks shall be not less than 200 mm (8 inches) in length. Blocks shall be shaped so that joints seal and bond effectively with cement mortar. Parge structure interior and exterior with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.
  2. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
  3. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.

4. Flat top manhole tops shall be reinforced concrete as detailed on the drawings.
5. Mortar:
  - a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, 1/4 part lime hydrate, and 3 parts sand.
  - b. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21 L (5-1/2 gallons) per sack of cement.
6. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M198.
7. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words "sanitary sewer". The studs and the lettering shall be raised 8 mm (5/16 inch). The cover shall be a minimum of 600 mm (24 inches) in diameter and shall have four 19 mm (3/4 inch) vent holes and two lifting slots. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.

#### **2.4 CONCRETE:**

Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03 of these specifications.

et) of overburden with the hole fully flooded with a 3.1 safety factor against leaking.

#### **2.5 CONCRETE PROTECTIVE COATING:**

Concrete coating for the interior of wet wells shall consist of an epoxy blended filler sealer, and a cross linked epoxy phenolic cured, resistant protective coating.

#### **2.6 GATE VALVES:**

- A. AWWA C509, resilient seated gate valves rated for 1360 kPa (200 psi) WSP, reduced-wall resilient seated gates valves may be supplied in

accordance with AWWA C515. Asbestos packing is prohibited. The interior and exterior of the valve shall be epoxy coated for AWWA C550.

**B. Operation:**

1. Shall turn counterclockwise to open.
2. Underground: 50 mm (2 inch) nut for socket wrench operation.
3. Above Ground and In Pits: Handwheels.

**C. Joints:** End of valve shall accommodate, or be adapted to, pipe furnished.

**2.7 VALVE BOXES:**

- A. Cast iron extension box with screw or slide-type adjustment and flared base. Minimum thickness of metal shall be 5 mm (3/16 inch). Box shall be of such length as will be adapted, without full extension, to depth of cover required over pipe at valve location.
- B. Cast the word "SEWER" on the cover.
- C. Provide Three (3) "T" handle socket wrenches, of 16 mm (5/8 inch) round stock long enough to extend 600 mm (2 feet) above top of deepest valve box.

**2.8 CHECK VALVES**

Check valves shall be swing-check valves conforming to AWWA C508. The interior and exterior of the valve shall be epoxy coated per AWWA C550. The check valve shall be rated for minimum of 850 kPa (125 psi) working pressure.

**2.9 WARNING TAPE:**

Standard, .1mm (4Mil) polyethylene 76 mm (3 inch) wide tape detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

**PART 3 - EXECUTION**

**3.1 BUILDING SERVICE LINES:**

- A. Install sanitary sewer service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.
- B. Connections of service line to building piping shall be made after the new sanitary sewer system has been constructed, tested, and accepted

for operation by the Contracting Officer Representative. The Contractor shall install all temporary caps or plugs required for testing.

- C. When building services have not been installed at the time when the sanitary sewer system is complete, provide temporary plugs or caps at the ends of all service lines. Mark the location and depth of the service lines with continuous warning tape placed 300 mm (12 inches) above service lines.

### **3.2 REGRADING:**

- A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.
- C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

### **3.3 CONNECTIONS TO EXISTING VA OWNED MANHOLES:**

- A. During construction of new connections to existing manholes, it shall be the sole responsibility of the Contractor to maintain continued sanitary sewer service to all buildings and users upstream. The contractor shall provide, install, and maintain all pumping, conveyance system, dams, weirs, etc. required to maintain the continuous flow of sewage. All temporary measures required to meet this requirement shall be subject to the review of the Contracting Officer Representative.
- B. Core existing structure, install pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.

- C. The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all pipes connected to the manhole.
- D. Connections and alterations to existing manholes shall be constructed so that finished work conforms as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting and shaping.

**3.4 PIPE SEPARATION:**

**A. Horizontal Separation - Water Mains and Sewers:**

- 1. Existing and proposed water mains shall be at least 3 meters (10 feet) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
- 2. Gravity flow mains and pressure (force) mains may be located closer than 3 meters (10 feet) but not closer than 1.8 m (6 feet) to a water main when:
  - a. Local conditions prevent a lateral separation of ten feet; and
  - b. The water main invert is at least 450 mm (18 inches) above the crown of the gravity sewer or 600 mm (24 inches) above the crown of the pressure (force) main; and
  - c. The water main is in a separate trench separated by undisturbed earth.
- 3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe. The pipe for the sanitary sewer main shall comply with the specifications for pressure (force) mains, and the water main material shall comply with Section 33 10 00, WATER UTILITIES. The sewer shall be pressure tested as specified for pressure (force) mains before backfilling.

**B. Vertical Separation - Water Mains and Sewers at Crossings:**

- 1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 600 mm (24 inches) above the crown of gravity flow sewer or 1200 mm (48 inches) above the crown of pressure (force) mains. The vertical separation shall be maintained within 3 meters (10 feet) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.

2. In no case shall pressure (force) sanitary main cross above, or within 600 mm (24 inches) of water lines.
3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 450 mm (18 inches) above or 300 mm (12 inches) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 600 mm (24 inches) below the water line provided both the water line and sewer line are constructed of ductile iron pipe. The pipe for the sewer shall conform to the requirements for pressure sewers specified herein. Piping for the water main shall conform to Section 33 10 00, WATER UTILITIES.
4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 3 meters (10 feet).

### **3.5 GENERAL PIPING INSTALLATION:**

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade. Pressure (force) mains shall have the bells facing the direction of flow.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not lay sewer pipe in same trench with another pipe or other utility. Sanitary sewers shall cross at least 600 mm (2 feet) below water lines.

- H. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 300 mm (12 inches) over the crown of the pipe.
- I. Warning tape shall be continuously placed 300 mm (12 inches) above sewer pipe
- J. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
  - 1. Ductile Iron Piping: AWWA C111 and C600.
  - 2. Vitrified Clay Piping: ASTM C12.
  - 3. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
  - 4. High Density Polyethylene (HDPE) Piping: Comply with manufacturer's recommendations with gaskets with fused joints.
- K. Gravity Flow Lines with Secondary Containment:
  - 1. Install per manufacturer's recommendations. Install all pipe centering devices to maintain an interstitial space below the invert of the carrier pipe. Both the carrier and containment pipe shall be tested for leaks.
- L. Installation of Pressure (Force) Mains:
  - 1. Sections of piping listed on the drawings shall be fully restrained using approved joint restraint devices. Joint restraint devices shall be installed in accordance with the manufacturer's recommendations. For devices with twist of nuts, the twist of nuts shall be placed on top of the fitting for the Engineer's inspection. The Contractor shall torque test all bolts, set screws, identified by the Contracting Officer Representative.
  - 2. Thrust blocks shall not be permitted.
  - 3. Install pressure (force) mains in accordance with the provisions of these specifications and the following standards:
    - a. Ductile Iron Piping: AWWA C111 and C600.
    - b. Polyvinyl Chloride (PVC) Piping: AWWA C605.
    - c. High Density Polyethylene (HDPE) Piping: Per manufacturer's recommendations.

### **3.6 MANHOLES:**

- A. General:
  - 1. Circular Structures:

- a. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
  - b. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top, shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
  - c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.
2. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
  - a. Forming directly in concrete base of structure.
4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (1-inch per foot) nor more than 1:6 (2 inches per foot). Bottom slab and benches shall be concrete.
5. The wall that support access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
6. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
7. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inches) thick, by 300



mm (12 inches) concrete collar around the perimeter of the frame.

Slope the top of the collar away from the frame.

### **3.8 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES:**

Reinforced concrete as detailed on the drawings. The concrete shall not restrict access for future maintenance of the joints within the piping system.

### **3.9 CLEANOUTS:**

- A. 150 millimeters (6 inches) in diameter and consisting of a ductile iron 45 degree fitting on end of run, or combination Y fitting and 1/8 bend in the run with ductile iron pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Center-set cleanouts, located in unpaved areas, in a 300 by 300 by 150 mm (12 by 12 by 6 inches) thick concrete slab set flush with adjacent finished grade. Where cleanout is in force main, provide a blind flange top connection. The center of the flange shall be equipped with a 50 mm (2 inches) base valve to allow the pressure in the line to be relieved prior to removal of the blind flange. Frames and covers for pressure (force) mains shall be 600 mm (24 inches) in diameter.
- B. The top of the cleanout assembly shall be 50 mm (2 inches) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

### **3.10 SETTING OF GATE VALVES:**

- A. Avoid setting valves under pavement except where shown on the drawings.
- B. Clean valve interior before installation.
- C. Set valve plumb, restrain ends of valves when indicated on the drawing.
- D. Set valve box cover flush with the finished grade. Valve box shall be centered over the operating nut.

### **3.11 SETTING OF CHECK VALVES:**

- A. Check valves shall be installed in a vault, direct burial of check valves shall not be permitted.
- B. Check valves shall be set in the horizontal position, with adequate clearance to the structure to allow for movement of the lever and maintenance of the valve.
- C. Clean the interior of the valve and check its operation prior to installation.

- D. After installation, adjust the weight on the lever to provide proper operation in accordance with the manufacturer's recommendations.

**3.12 INSPECTION OF SEWERS:**

Inspect and obtain the Contracting Officer Representative's approval. Thoroughly flush out before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lip at joints on the inside of gravity sewer lines are not acceptable.

**3.13 TESTING OF SANITARY SEWERS:**

A. Gravity Sewers and Manholes

1. Air Test: Vitrified Clay Pipe ASTM C828. PVC Pipe, Uni-Bell Uni-B-6. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 28 kPa (4 psi) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 24 kPa (3.5 psi) greater than the average back-pressure of any groundwater above the sewer. The minimum test time shall be as specified in Uni-Bell Uni-B-6.
2. Exfiltration Test:
  - a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 900 mm (3 feet) above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During one hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11 L (3.0 gallons) per hour per 30 m (100 feet).
  - b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.
3. Infiltration Test: If ground water level is greater than 900 mm (3 feet) above invert of the upper manhole, infiltration tests are acceptable. Allowable leakage for this test will be the same as for the exfiltration test.

--- E N D ---

**SECTION 33 40 00**  
**STORM SEWER UTILITIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

**1.2 RELATED WORK**

A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 ABBREVIATIONS**

A. HDPE: High-density polyethylene

B. PE: Polyethylene

**1.4 DELIVERY, STORAGE, AND HANDLING**

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Handle manholes catch basins and storm water inlets according to manufacturer's written rigging instructions.

**1.5 COORDINATION**

A. Coordinate connection to storm sewer main with the Public Agency providing storm sewer off-site drainage.

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

**1.6 QUALITY ASSURANCE:**

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

**1.7 SUBMITTALS**

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

1. Section of each manhole structure.

**1.8 APPLICABLE PUBLICATIONS**

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

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

A185/A185M-07.....Steel Welded Wire Reinforcement, Plain, for  
Concrete

A242/A242M-04(2009).....High-Strength Low-Alloy Structural Steel

A615/A615M-09b.....Deformed and Plain Carbon-Steel Bars for  
Concrete Reinforcement

A760/A760M-10.....Corrugated Steel Pipe, Metallic-Coated for  
Sewers and Drains

A798/A798M-07.....Installing Factory-Made Corrugated Steel Pipe  
for Sewers and Other Applications

A849-10.....Post-Applied Coatings, Paving, and Linings for  
Corrugated Steel Sewer and Drainage Pipe

A929/A929M-01(2007).....Steel Sheet, Metallic-Coated by the Hot-Dip  
Process for Corrugated Steel Pipe

B745/B745M-97(2005).....Corrugated Aluminum Pipe for Sewers and Drains

B788/B788M-09.....Installing Factory-Made Corrugated Aluminum  
Culverts and Storm Sewer Pipe

C33/C33M-08.....Concrete Aggregates

C76-11.....Reinforced Concrete Culvert, Storm Drain, Pipe

C139-10.....Concrete Masonry Units for Construction of  
Catch Basins and Manholes

C150/C150M-11.....Portland Cement

C443-10.....Joints for Concrete Pipe and Manholes, Using  
Rubber Gaskets

C478-09.....Precast Reinforced Concrete Manhole Sections

C506-10b.....Reinforced Concrete Arch Culvert, Storm Drain,  
and Sewer Pipe

C507-10b.....Reinforced Concrete Elliptical Culvert, Storm  
Drain, and Sewer Pipe

C655-09.....Reinforced Concrete D-Load Culvert, Storm  
Drain, and Sewer Pipe

C857-07.....Minimum Structural Design Loading for  
Underground Precast Concrete Utility Structures

C891-09.....Installation of Underground Precast Concrete  
Utility Structures

C913-08.....Precast Concrete Storm Drain Structures

C923-08.....Resilient Connectors Between Reinforced  
Concrete Manhole Structures, Pipes, and  
Laterals

C924-02(2009).....Testing Concrete Pipe by Low-Pressure Air Test  
Method

C990-09.....Joints for Concrete Pipe, Manholes, and Precast  
Box Sections Using Preformed Flexible Joint  
Sealants

C1433-10.....Precast Reinforced Concrete Monolithic Box  
Sections for Culverts, Storm Drains, and Sewers

C1479-10.....Installation of Precast Concrete Sewer, Storm  
Drain, and Culvert Pipe Using Standard  
Installations

D448-08.....Sizes of Aggregate for Road and Bridge  
Construction

D698-07e1.....Laboratory Compaction Characteristics of Soil  
Using Standard Effort (12 400 ft-lbf/ft<sup>3</sup> (600  
kN-m/m<sup>3</sup>))

D1056-07.....Flexible Cellular Materials—Sponge or Expanded  
Rubber

D1785-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe,  
Schedules 40, 80, and 120

D2321-11.....Underground Installation of Thermoplastic Pipe  
for Sewers and Other Gravity-Flow Applications

D2751-05.....Acrylonitrile-Butadiene-Styrene (ABS) Sewer  
Pipe and Fittings

D2774-08.....Underground Installation of Thermoplastic  
Pressure Piping

D3034-08.....Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe  
and Fittings

D3350-10.....Polyethylene Plastics Pipe and Fittings  
Materials

D3753-05e1.....Glass-Fiber-Reinforced Polyester Manholes and  
Wetwells

D4101-11.....Polypropylene Injection and Extrusion Materials

D5926-09.....Poly (Vinyl Chloride) (PVC) Gaskets for Drain,  
Waste, and Vent (DWV), Sewer, Sanitary, and  
Storm Plumbing Systems

F477-10.....Elastomeric Seals (Gaskets) for Joining Plastic  
Pipe

F679-08.....Poly(Vinyl Chloride) (PVC) Large-Diameter  
Plastic Gravity Sewer Pipe and Fittings

F714-10.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based  
on Outside Diameter

F794-03(2009).....Poly(Vinyl Chloride) (PVC) Profile Gravity  
Sewer Pipe and Fittings Based on Controlled  
Inside Diameter

F891-10.....Coextruded Poly(Vinyl Chloride) (PVC) Plastic  
Pipe With a Cellular Core

F894-07.....Polyethylene (PE) Large Diameter Profile Wall  
Sewer and Drain Pipe

- F949-10.....Poly(Vinyl Chloride) (PVC) Corrugated Sewer  
Pipe With a Smooth Interior and Fittings
- F1417-11.....Installation Acceptance of Plastic Gravity  
Sewer Lines Using Low-Pressure Air
- F1668-08.....Construction Procedures for Buried Plastic Pipe
- C. American Association of State Highway and Transportation Officials  
(AASHTO):
- M190-04.....Bituminous-Coated Corrugated Metal Culvert Pipe  
and Pipe Arches
- M198-10.....Joints for Concrete Pipe, Manholes, and Precast  
Box Sections Using Preformed Flexible Joint  
Sealants
- M252-09.....Corrugated Polyethylene Drainage Pipe
- M294-10.....Corrugated Polyethylene Pipe, 12 to 60 In. (300  
to 1500 mm) Diameter
- D. American Water Works Association(AWWA):
- C105/A21.5-10.....Polyethylene Encasement for Ductile iron Pipe  
Systems
- C110-08.....Ductile-Iron and Gray-Iron Fittings
- C219-11.....Bolted, Sleeve-Type Couplings for Plain-End  
Pipe
- C600-10.....Installation of Ductile iron Mains and Their  
Appurtenances
- C900-07.....Polyvinyl Chloride (PVC) Pressure Pipe and  
Fabricated Fittings, 4 In. Through 12 In. (100  
mm Through 300 mm), for Water Transmission and  
Distribution
- M23-2nd ed.....PVC Pipe "Design And Installation"
- E. American Society of Mechanical Engineers (ASME):
- A112.6.3-2001.....Floor and Trench Drains
- A112.14.1-2003.....Backwater Valves

A112.36.2M-1991.....Cleanouts

F. American Concrete Institute (ACI):

318-05.....Structural Commentary and Commentary

350/350M-06.....Environmental Engineering Concrete Structures  
and Commentary

G. National Stone, Sand and Gravel Association (NSSGA): Quarried Stone for  
Erosion and Sediment Control

## **1.9 WARRANTY**

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

## **PART 2 - PRODUCTS**

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

A. Standardization of components shall be maximized to reduce spare part requirements. The 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.

### **2.2 CONCRETE PIPE AND FITTINGS**

A. Non-Reinforced-Concrete sewer pipe and fittings shall be ASTM C14, Class 3, with bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C443, rubber gaskets sealant joints with ASTM C990, bitumen or butyl-rubber sealant

B. Reinforced-Concrete sewer pipe and fittings shall be ASTM C76 or ASTM C655.

1. Bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C443, rubber gaskets sealant joints with ASTM C990, bitumen or butyl-rubber sealant.

2. Class III: Wall A



## 2.3 CLEANOUTS

A. Cast-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Top-Loading Classification(s): Heavy Duty
2. Pipe fitting and riser to cleanout shall be same material as main pipe line.
3. Plastic Cleanouts shall have PVC body with PVC threaded plug. Pipe fitting and riser to cleanout shall be of same material as main line pipe.

## 2.4 MANHOLES AND CATCH BASINS

A. Standard Precast Concrete Manholes:

1. Description: ASTM C478 (ASTM C478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6 inch (150 mm) minimum thickness for floor slab and 4-inch (102 mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4 inch (102 mm) minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.
9. Steps: If total depth from floor of manhole to finished grade is greater than 60 inches (1500 mm). ASTM A615, deformed, 1/2 inch (13 mm) steel reinforcing rods encased in ASTM D4101, width of 16 inches (400 mm) minimum, spaced at 12 to 16 inch (300 to 400 mm) intervals.
10. Adjusting Rings: Reinforced-concrete rings, 6 to 9 inch (150 to 225 mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24 inch (610 mm) ID by 7 to 9 inch (175 to 225 mm) riser with 4 inch (102 mm) minimum width flange and 26-inch (600 mm) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A536, Grade 60-40-18 ductile iron unless otherwise indicated.

**2.5 CONCRETE FOR MANHOLES AND CATCH BASINS**

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C150, Type II.
2. Fine Aggregate: ASTM C33, sand.
3. Coarse Aggregate: ASTM C33, crushed gravel.
4. Water: Potable.

B. Concrete Design Mix: 4000 psi (27.6 MPa) minimum, compressive strength in 28 days.

1. Reinforcing Fabric: ASTM A185, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Channels shall be the main line pipe material. Include benches in all manholes and catch basins.

1. Channels: Main line pipe material or concrete invert. Height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: Same slope as the main line pipe. Bench to be concrete, sloped to drain into channel. Minimum of 6 inch slope from main line pipe to wall sides.

**2.6 PIPE OUTLETS**

A. Head walls: Cast in-place reinforced concrete, with apron and tapered sides.

B. Riprap basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Size: NSSGA No. R-5, screen opening 5 inches (127 mm).

**2.7 HEADWALLS**

A. Headwalls: Cast in-place concrete with a minimum compressive strength of 3000 psi (20 MPa) at 28 days.

## **2.8 WARNING TAPE**

- A. Standard, 4-Mil polyethylene 3 inch (76 mm) wide tape detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

## **PART 3 - EXECUTION**

### **3.1 PIPE BEDDING**

- A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

### **3.2 PIPING INSTALLATION**

- A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping as shown on the Drawings.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
  - 2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.

3. Inspect pipes and fittings, for defects before installation.  
Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
6. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches (300 mm) over the crown of the pipe.
7. Warning tape shall be continuously placed 12 inches (300 mm) above storm sewer piping.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- F. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- G. Install gravity-flow, nonpressure drainage piping according to the following:
  1. Install piping pitched down in direction of flow.
  2. Install corrugated steel piping according to ASTM A798.

### **3.3 REGRADING**

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover

shall be installed above the high flow elevation within the structure,  
and shall prevent debris from entering the wastewater stream.

### **3.4 CONNECTIONS TO EXISTING MANHOLES**

- A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

### **3.5 CATCH BASIN INSTALLATION**

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

### **3.6 CONNECTIONS**

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section FACILITY STORM DRAINAGE PIPING.
- B. Encase entire connection fitting, plus 6 inch (150 mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
- C. Make connections to existing piping and underground manholes.
  - 1. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, use epoxy-bonding compound as interface between new and existing concrete and piping materials.
  - 2. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
  - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
    - a. Flexible couplings for same OD pipes.

- b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
  - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
2. Use pressure-type pipe couplings for force-main joints.

### **3.7 CLOSING ABANDONED STORM DRAINAGE SYSTEMS**

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
- 1. Close open ends of piping with at least 8 inch (203 mm) thick, concrete
  - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

### **3.8 IDENTIFICATION**

- A. Install green warning tape directly over piping and at outside edge of underground structures.

### **3.9 FIELD QUALITY CONTROL**

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
- 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Reinspect and repeat procedure until results are satisfactory.

### **3.10 TESTING OF STORM SEWERS:**

- A. Submit separate report for each test.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  - 1. Do not enclose, cover, or put into service before inspection and approval.
  - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
  - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
  - 4. Submit separate report for each test.
  - 5. Air test gravity sewers. Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
  - 6. Test force-main storm drainage piping. Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psi (1035 kPa).
- C. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

### **3.11 CLEANING**

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

--- E N D ---





**SECTION 33 51 00**

**NATURAL-GAS DISTRIBUTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies materials and procedures for the construction of outside underground gas distribution system for natural gas, complete, ready for operation.

**1.2 RELATED WORK**

- A. All Sections listed in the Table of Contents are a Condition of this Section.

**1.3 DEFINITIONS**

- A. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

**1.4 ABBREVIATIONS**

- A. WOG: Water, oil and gas
- B. NRTL: National recognized testing laboratory

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

**1.6 COORDINATION**

- A. Coordinate connection to natural-gas main with Utility Company.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

**1.7 QUALITY ASSURANCE:**

- A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the Utility Company having jurisdiction over the connection to public natural-gas lines and the extension, and/or modifications to public utility systems.

#### **1.8 APPLICABLE PUBLICATIONS**

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

B. American National Standards Institute (ANSI):

B31.8-2010.....Gas Transmission and Distribution Piping  
Systems

B109.1-92.....Diaphragm-Type Gas Displacement Meters (Under  
500-Cubic-Feet-per-hour Capacity)

B109.2-2000.....Diaphragm-Type Gas Displacement Meters (500-  
Cubic-Feet-per-hour Capacity and over)

B109.3-92.....Rotary-Type Gas Displacement Meters

IAS LC 1-2005.....Fuel Gas Piping Systems Using Corrugated  
Stainless Steel Tubing (CSST)

Z21.18-07/CSA 6.3-07....Gas Appliance Pressure Regulators

Z21.21-2005/CSA 6.5.....Automatic Valves for Gas Appliances

Z21.41-2003/CSA 6.9.....Quick Disconnect Devices for Use with Gas Fuel  
Appliances

Z21.75-2007/CSA 6.27....Connectors for Outdoor Gas Applications and  
Manufactured Homes

Z21.80a-2005/CSA 6.22a..Line Pressure Regulators, Addenda 1 to Z21.80-  
2003/CSA 6.22

C. American Petroleum Institute (API):

Spec 6D-2010.....Pipeline Valves

D. American Society of Civil Engineers (ASCE):

25-06.....Earthquake Actuated Automatic Gas Shutoff  
Devices

E. American Society of Mechanical Engineers (ASME):

B1.20.1-1983.....Pipe Threads, General Purpose, Inch

B1.20.3-2008.....Dryseal Pipe Threads (Inch)

B16.3-2006.....Malleable Iron Threaded Fittings: Classes 150  
and 300

B16.5-2009.....Pipe Flanges and Flanged Fittings: NPS 1/2  
through NPS 24 Metric/Inch Standard

B16.9-2007.....Factory-Made Wrought Buttwelding Fittings

B16.11-2009.....Forged Fittings, Socket-Welding and Threaded

B16.20-2007.....Metallic Gaskets for Pipe Flanges: Ring-Joint,  
Spiral-Wound, and Jacketed

B16.26-2006.....Cast Copper Alloy Fittings for Flared Copper  
Tubes

B16.33-2002.....Manually Operated Metallic Gas Valves for use  
in Gas Piping Systems up to 125 psi (Sizes NPS  
1/2 through NPS 2)

B16.34-2009.....Valves - Flanged, Threaded and Welded End

B16.38-2007.....Large Metallic Valves for Gas Distribution  
Manually Operated, NPS 2-1/2 (DN 65) to NPS 12  
(DN 300), 125 psig (8.6 bar) Maximum

B16.39-2009.....Malleable Iron Threaded Pipe Unions: Classes  
150, 250, and 300

B16.40-2008.....Manually Operated Thermoplastic Gas Shutoffs  
and Valves in Gas Distribution Systems

B18.2.1-2010.....Square, Hex, Heavy Hex, and Askew Head Bolts  
and Hex, Heavy Hex, Hex Flange, Lobed Head, and  
Lag Screws (Inch Series)

B31.8-2010.....Gas Transmission and Distribution Piping  
Systems

MFC-4M-1986.....Measurement of Gas Flow by Turbine Meters

F. American Society of Safety Engineers (ASSE):

1079-2005.....Dielectric Pipe Unions

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

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

A126-042009).....Gray Iron Castings for Valves, Flanges, and  
Pipe Fittings

A234/A234M-11.....Piping Fittings of Wrought Carbon Steel and  
Alloy Steel for Moderate and High Temperature  
Service

A312/A312M-11.....Seamless, Welded, and Heavily Cold Worked  
Austenitic Stainless Steel Pipes

B210-04.....Aluminum and Aluminum-Alloy Drawn Seamless  
Tubes

B241/B241M-10.....Aluminum and Aluminum-Alloy Seamless Pipe and  
Seamless Extruded Tube

B584-11.....Copper Alloy Sand Castings for General  
Applications

D2513-11e1.....Polyethylene (PE) Gas Pressure Pipe, Tubing,  
and Fittings

D2517-06.....Reinforced Epoxy Resin Gas Pressure Pipe and  
Fittings

D2683-10.....Socket-Type Polyethylene Fittings for Outside  
Diameter-Controlled Polyethylene Pipe and  
Tubing

D2774-08.....Underground Installation of Thermoplastic  
Pressure Piping

D3261-10a.....Butt Heat Fusion Polyethylene (PE) Plastic  
Fittings for Polyethylene (PE) Plastic Pipe and  
Tubing

E84-11.....Standard Test Method for Surface Burning  
Characteristics of Building Materials

H. American Water Works Association (AWWA):

C203-08.....Coal-Tar Protective Coatings and Linings for  
Steel Water Pipelines - Enamel and Tape - Hot  
Applied

I. American Welding Society (AWS):

A5.8/A5.8M:2004.....Filler Metals for Brazing and Braze Welding

D10.12/D10.12M:2000.....Guide for Welding Mild Steel Pipe

J. Manufacturers Standardization Society (MSS):

SP-78-2005.....Gray Iron Plug Valves Flanged and Threaded Ends

SP-110-2010.....Ball Valves Threaded, Socket-Welding, Solder  
Joint, Grooved and Flared Ends

K. National Fire Protection Agency (NFPA):

54-2009.....National Fuel Gas Code

70-2011.....National Electric Code

L. Society of Automotive Engineers (SAE):

J513-199901.....Refrigeration Tube Fittings - General  
Specifications \*HS-150/2000\*

M. Underwriters Laboratories (UL):

UL 429-2010.....Electrically Operated Valves

**1.9 WARRANTY**

A. The Contractor shall remedy any defect due to faulty material or  
workmanship and pay for any damage to other work resulting therefrom  
within a period of two years from final acceptance. Further, the

Contractor will furnish all manufacturer's and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

## **PART 2 - PRODUCTS**

### **2.1 PIPES, TUBES, AND FITTINGS**

A. Steel Pipe: Steel pipe shall be as per ASTM A53, black steel, Schedule 40, Type E, Grade B. Copper tubes are not allowed by code for natural gas distribution in the United States.

B. Fittings:

1. Malleable-Iron Threaded Fittings shall meet ASME B16.3, standard pattern. Threaded joints are not permitted except at valve connections.
2. Butt weld fittings shall be wrought steel, per ASME B16.9.
3. Wrought-Steel Welding Fittings shall meet ASTM A234 for butt welding and socket welding.
4. Unions shall be ASME B16.39, Class 300, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
5. Forged-Steel Flanges and Flanged Fittings shall be ASME B16.11, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - a. Material Group: 1.1.
  - b. End Connections shall be threaded or butt welded to match pipe.
  - c. Lapped Face is not permitted underground.
  - d. Gasket Materials shall be ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
  - e. Bolts and Nuts shall be ASME B18.2.1, carbon steel aboveground and stainless steel underground.
6. Protective Coating for Underground Piping:
  - a. Factory-applied, three-layer coating of epoxy, adhesive, and polyethylene PE).
  - b. Joint cover kits shall include epoxy paint, adhesive, and heat-shrink PE sleeves.

### **2.2 JOINING MATERIALS**

A. Joint Compound and Tape shall be suitable for natural-gas.

B. Welding filler metals shall comply with AWS D10.12 for appropriate wall thickness and chemical analysis of steel pipe being welded.

### **2.3 MANUAL GAS SHUTOFF VALVES**

A. All types of valves shall be accessible, labeled and specified for use for controlling multiple systems.

B. Metallic Valves, NPS 2 (DN 50) and smaller shall comply with ASME B16.33.

1. CWP Rating.

2. Threaded ends complying with ASME B1.20.1.

3. Dryseal threads on flare ends that comply with ASME B1.20.3.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.

5. Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

C. Valve Boxes shall be cast iron, two-section box.

1. Top section shall include a cover with "GAS" lettering.

2. Bottom section shall have a base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.

3. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

### **2.4 EARTHQUAKE VALVES**

A. Valves shall automatically stop gas flow when actuated by earth tremor and shall be single seated with manual reset. Do not provide manual shut-off attachments.

1. Valve shall comply with ASCE 25 and automatically shut bubble tight within five seconds when subjected to a horizontal sinusoidal oscillation having a peak acceleration of 0.3 gravity with a period of 0.4 seconds. The valve shall not shut-off when subjected for five seconds to horizontal, sinusoidal oscillations having a peak acceleration of 0.4 gravity with a period of 0.1 second; a peak acceleration of 0.08 gravity with a period of 0.4 second or 1.0 second.

2. Valve should be rated for 125 psi (850 kPa) with flanged ends for pipe sizes above 2 inches (50 mm). Valves should have threaded ends for pipe sizes 2 inches (50 mm) and under.

3. Approvals: UL listed, State of California Standards for Earthquake Actuated Automatic Gas Shut-Off Systems.

## **2.5 VALVE BOXES**

- A. Provide cast iron extension box with screw or slide type adjustment and flared base. Minimum thickness of metal, 3/16 inch (5 mm). Box shall be of such length as can be adapted, without full extension, to depth of cover required over pipe at valve location with the word "GAS" in cover.
- B. Provide "T" handle socket wrenches of 5/8 inch (16 mm) round stock long enough to extend 2 feet (600 mm) above top of deepest valve box.

## **2.6 PRESSURE REGULATORS**

- A. Pressure regulators for individual service lines shall be capable of reducing distribution line pressure to pressures required for users. Ferrous bodies. Regulators should be:
1. Single stage and suitable for natural-gas, having a steel jacket and corrosion-resistant components and elevation compensator. End Connections should be threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.
- B. Service Pressure Regulators shall comply with ANSI Z21.80a/CSA 6.22a.

## **2.7 SERVICE METERS**

- A. Meters shall comply with Section 25 10 10, ADVANCED UTILITY METERING SYSTEM and ANSI B109.2.
- B. Gas meters shall be of type approved by local gas Utility as specified herein.
- C. Meters shall be pedestal mounted. Meters shall be provided with over-pressure protection as specified in ASME B31.8.
- D. Service-Meter bypass fittings shall be ferrous, tee, pipe fitting with capped side inlet for temporary natural-gas supply, having an integral ball-check bypass valve.

## **2.8 LABELING AND IDENTIFYING**

- A. Detectable warning tape shall be acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.



## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Close equipment shutoff valves before turning off natural-gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

### **3.2 METALLIC PIPING INSTALLATION**

- A. Heating trenches, storm and sanitary sewer lines, and water mains shall have right of way.
- B. Warning tape shall be continuously placed 12 inches (300 mm) above buried gas lines.
- C. Main services and main service shut off valves shall have a 24 inch (600 mm) minimum cover or as recommended by local utility.
- D. Service lines shall have an 18 inch (450 mm) minimum cover or as recommended by local utility.
- E. Connections between metallic and plastic piping shall be made only outside, underground, and with approved transition fittings.

### **3.3 BUILDING SERVICE LINES**

- A. Before entering building, underground service line shall rise above grade close to building to permit possible gas leaks to vent themselves.
- B. Install gas service lines to point of connection within approximately 5 feet (1500 mm) outside of buildings to which such service is to be connected and make connections thereto.
- C. Connect service lines to top of mains by two-strap service clamp or coupling socket) welded to main and into which is screwed a street tee and street elbow swing, joint assembly.
- D. The service lines shall be as short and as straight as practicable between the point of delivery and the gas main and shall not be bent or curved laterally unless necessary to avoid obstructions or otherwise permitted. Service lines shall be laid with as few as joints as practicable using standard lengths of pipe. Polyethylene or fiberglass service lines shall not be installed aboveground except as permitted in ANSI B31.8.

- E. Install gas service lines to point of connection within approximately 5 feet (1500 mm) outside of buildings to which such service is to be connected and make connections thereto.

### **3.4 VALVE BOXES**

- A. Set cover flush with finished grade.
- B. Protect boxes located in roadway against movement by a concrete slab at least 3 feet (900 mm) square by 6 inches (150 mm) deep.
- C. Set other valve boxes with a concrete slab 18 inches (450 mm) by 18 inches (450 mm) by 6 inches (150 mm) deep and set flush with grade.
- D. All exposed portions of valve boxes shall be painted bright yellow.

### **3.5 CONNECTIONS**

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Install tee fitting with capped nipple in bottom to form drip sediment traps. Install as close as practical to inlet of each appliance.

### **3.6 LABELING AND IDENTIFYING**

- A. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

### **3.7 PIPE CLEANING**

- A. All pipe sections shall be blown down with 100 psi (690 kPa) air to remove all sand, soil and debris.
- B. Blow down procedure shall be done after system is complete, but before valves are installed.

### **3.8 TESTS**

- A. Piping System: Inspection, testing and purging shall be in accordance with NFPA 54 and ASME B31.8.

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