

PROJECT MANUAL

VA Health Care System
OPTOMETRY TRAILER SITE PREP
Saint Cloud, Minnesota



Project Number 656-15-267

VOLUME 1 of 1



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Project Number: JLG 15125F

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100% Construction Documents - For Construction

**DEPARTMENT OF VETERANS AFFAIRS
VHA MASTER SPECIFICATIONS**

**TABLE OF CONTENTS
Section 00 01 10**

	DIVISION 00 - SPECIAL SECTIONS	DATE
00 01 15	List of Drawing Sheets	07-15
	DIVISION 01 - GENERAL REQUIREMENTS	
01 00 00	General Requirements	11-15
01 32 16.15	Project Schedules (Small Projects - Design/Bid/Build	04-13
01 33 23	Shop Drawings, Product Data, and Samples	07-15
01 35 26	Safety Requirements	10-14
01 42 19	Reference Standards	07-15
01 45 29	Testing Laboratory Services	06-15
01 57 19	Temporary Environmental Controls	01-11
01 74 19	Construction Waste Management	09-13
	DIVISION 02 - EXISTING CONDITIONS	
02 41 00	Demolition	02-15
	DIVISION 03 - CONCRETE	
03 30 53	(Short-Form) Cast-in-Place Concrete	10-12
	DIVISION 07 - THERMAL AND MOISTURE PROTECTION	
07 84 00	Firestopping	10-15
07 92 00	Joint Sealants	10-15
	DIVISION 09 - FINISHES	
09 91 00	Painting	12-15
	DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)	
23 09 23	Direct-Digital Control System for HVAC	09-11
	DIVISION 26 - ELECTRICAL	
26 05 11	Requirements for Electrical Installations	07-15
26 05 19	Low-Voltage Electrical Power Conductors and Cables	07-13
26 05 26	Grounding and Bonding for Electrical Systems	12-12
26 05 33	Raceway and Boxes for Electrical Systems	05-14
26 05 41	Underground Electrical Construction	12-12
26 05 73	Overcurrent Protective Device Coordination Study	12-15
26 22 00	Low-Voltage Transformers	12-15
26 24 16	Panelboards	05-14
26 36 23	Automatic Transfer Switches	12-12
	DIVISION 31 - EARTHWORK	
31 20 11	Earthwork (Short Form)	10-12

	DIVISION 32 - EXTERIOR IMPROVEMENTS	
32 05 23	Cement and Concrete for Exterior Improvements	05-13
32 12 16	Asphalt Paving	09-15
32 17 23	Pavement Markings	04-10
32 90 00	Planting	10-11
	DIVISION 33 - UTILITIES	
33 10 00	Water Utilities	01-14
33 30 00	Sanitary Sewer Utilities	06-13

SECTION 00 01 15
LIST OF DRAWINGS

THE DRAWINGS LISTED BELOW ACCOMPANYING THIS SPECIFICATION FORM A PART OF THE CONTRACT.

DRAWING NO.	TITLE
GENERAL	
GI1	Project Cover Sheet
CIVIL	
C1.0	Existing Conditions
C2.0	Removals Plan
C3.0	Site Plan
C4.0	Utility Plan
C5.0	Grading Plan
C6.0	Erosion Control Plan
C7.0	Details
C7.1	Details
C7.2	Erosion Control/SWPPP Details
STRUCTURAL	
S0.1	General Notes and Special Inspections
S1.1	Foundation Plan
ARCHITECTURAL	
AS1	Modular Floor Plan (For Reference)
ELECTRICAL	
E001	Electrical- Symbols, Legend, and Abbreviations
E201	Electrical- Site Plan
E401	Electrical Plan- Building 48 Basement
E402	Electrical Plan- Building 48 First Floor
E501	Electrical Plan- Building 113. Building 48- Fire Alarm Riser
E601	Electrical Riser Diagram and Details

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**SECTION 01 00 00
GENERAL REQUIREMENTS**

TABLE OF CONTENTS

1.1 SAFETY REQUIREMENTS.....	1
1.2 GENERAL INTENTION.....	1
1.3 STATEMENT OF BID ITEM(S)	3
1.4 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR	4
1.5 CONSTRUCTION SECURITY REQUIREMENTS.....	4
1.6 OPERATIONS AND STORAGE AREAS.....	7
1.7 ALTERATIONS.....	14
1.8 DISPOSAL AND RETENTION.....	16
1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS.....	18
1.10 RESTORATION.....	18
1.11 PHYSICAL DATA.....	20
1.12 PROFESSIONAL SURVEYING SERVICES.....	21
1.13 LAYOUT OF WORK.....	21
1.14 AS-BUILT DRAWINGS.....	23
1.15 USE OF ROADWAYS.....	23
1.16 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.....	23
1.17 TEMPORARY USE OF EXISTING ELEVATORS.....	25
1.18 TEMPORARY TOILETS.....	25
1.19 AVAILABILITY AND USE OF UTILITY SERVICES.....	25
1.20 NEW TELEPHONE EQUIPMENT	27
1.21 TESTS.....	27
1.22 INSTRUCTIONS.....	28

1.23	GOVERNMENT-FURNISHED PROPERTY	29
1.24	RELOCATED EQUIPMENT AND ITEMS	30
1.25	HISTORIC PRESERVATION	31
1.26	REBATE DOCUMENTATION.....	31
1.27	SITE INSPECTIONS	33

SECTION 01 00 00
GENERAL REQUIREMENTS

1.1 SAFETY REQUIREMENTS

Refer to section 01 35 26, SAFETY REQUIREMENTS for safety and infection control requirements.

1.2 GENERAL INTENTION

- A. Contractor shall furnish all labor, materials, tools and equipment required to completely and satisfactorily perform the construction of the Site Prep for Optometry Building project.

The scope of work shall include but will not be limited to the complete installation of all structural foundation piers, site grading and flat work, landscaping, supporting utilities including Electrical, Waste, Water, phone, data and all others as shown on the contract documents.

- B. Visits to the site by Bidders may be made only by appointment with the Contracting Officer.

- C. Offices of JLG architects, as Architect-Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.

- D. Before placement and installation of work subject to tests by testing laboratory retained by the Contractor. The Contractor shall notify the COR not less than three work days in advance and shall coordinate with testing laboratory personnel to provide sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection.

- E. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA

police, be identified by project and employer, and restricted from unauthorized access.

- F. Prior to commencing work, general contractor shall provide proof that the project supervisor having an OSHA 30 certified "competent person" (CP) (29 CFR 1926.20(b)(2) will maintain a presence at the work site whenever the general or subcontractors are present.

G. Training:

1. The Contractor's project supervisor is required to attend GEMS and Safety training provided by VA St. Cloud. Training must be attended prior to being designated as a job supervisor on any VA St. Cloud construction project.
2. Beginning July 31, 2005, all employees of general contractor or subcontractors shall have the at minimum the 10-hour OSHA certified Construction Safety course and other relevant competency training, as determined by VA CP with input from the Infection Control Risk Assessment (ICRA) team.
3. Submit training records of all such employees for approval before the start of work.
4. Notice to proceed will be issued not less than 2 weeks after receipt of bonds; time extensions will not be granted because of the need for training.

H. Identification Badge:

All contractor employees working on this project will be required to obtain and wear while on VA property, a VA picture identification badge. The badge will only be issued to those employees having the appropriate OSHA Construction Safety Cards. The badges must be requested 2 weeks in advance of working on site and will be issued free of charge by the VA. All ID badges must be returned upon contract completion. There will be a \$200 charge for each PIV/Flash ID badge not returned at the end of the contract. There will be a \$25 charge for "facility" badges and "contractor" or consultant badges

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I. Project Acceptance (Substantial Completion):

1. The acceptance of a project for substantial completion is to include the following:

- a. The completion of all items to meet the criteria of the contract drawings and specifications to the satisfaction of the Contracting Officer's Representative (COR). Items for correction may be considered to be punch list items, as determined by the COR, if the COR finds them to be minor in correction. Value for the corrections will be held by the VA, as determined by the COR, until all corrections are completed to the satisfaction of the COR.
- b. The VA will not accept a project, or phase of a project as determined by contract documents, as substantially complete until a complete passing test and balance report of the HVAC system has been submitted and accepted as complete and passing by the COR. It is recommended that the HVAC system be completed with sufficient time to make corrections to submit a passing report. A time extension to the contract will not be considered for corrections to the HVAC system that are determined by the COR to be installation or design errors if within the contract.

1.3 STATEMENT OF BID ITEM(S)

- A. ITEM I, Contractor shall furnish all labor, materials, tools and equipment required to completely and satisfactorily perform the construction of the Site Prep for Optometry Building project.

The scope of work shall include but will not be limited to the complete installation of all structural foundation piers, site grading and flat work, landscaping, supporting utilities including Electrical, Waste, Water, phone, data and all others as shown on the contract documents.

- B. ALTERNATE NO.1: None

1.4 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, Contractor is to provide his/her own drawings and specifications as downloaded from WWW.FBO.gov

1.5 CONSTRUCTION SECURITY REQUIREMENTS

A. Security Plan:

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

B. Security Procedures:

1. General Contractor's employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
2. All contractor and subcontractor employees working on this project are subject to a background investigation. VA has the right to refuse to badge any employee that does not pass the background investigation. It is expected that the contractor will have the employee scheduled for the issuance of a badge well in advance of starting work. Due to the badge process, the employee will not be able come to the VA, receive badge, and conduct work on same day. There will be a \$200 fine for badges issued and not returned upon completion of project.

Contractor and subcontractor employees that will work on VA property shall submit the following information to the Contracting Officer's Representative (COR) when requesting a badge:

Sponsor/Manager Info for contractors: (Add name of sponsor)

Initial Badge Submission Requirements:

First, middle and last name (Legal name, as shown on picture ID)

Date of Birth (DOB)

Social Security Number (SSN)

Height

Eye Color

Hair Color

Name of Firm or Company

VA Contract Number

VA project name

Name of COR

3. Before starting work the General Contractor shall give one week's notice to the COR so that security arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.
4. For working outside the "regular hours" as defined in the contract, The General Contractor shall give 3 days' notice to the Contracting Officer so that security arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.
5. No photography of VA premises is allowed without written permission of the Contracting Officer.
6. VA reserves the right to close down or shut down the project site and order General Contractor's employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the Contracting Officer.

D. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the COR for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.
2. The General Contractor shall turn over all permanent lock cylinders to the VA locksmith for permanent installation. See Section 08 71 00, DOOR HARDWARE and coordinate.
3. Door hardware installed in construction doors is to be self-closing and storage function lock, able to receive a BEST 7 pin core and only operable with a key. The VA will install the construction core and issue keys to the contractor's personnel. All construction fences are to be locked with a VA lock in series so VA engineering and police personnel have emergency access at all times. Construction fences are to be kept locked at all times to prevent access by patients and VA unauthorized staff. Contractor is to provide means of egress from the site that keeps the site secure from the exterior. Keys to necessary construction areas can be checked out with the approval of the COR. The contractor is to give a minimum of 1 week notice for security approval for areas that need to be entered for construction purposes.
4. VA construction core keys will be issued to the contractor as deemed necessary by the COR. All keys must be returned when no longer needed or upon completion of the contract. **There will be a \$25 charge for each key not returned at the end of the contract. Should VA security be compromised as a result of failure to return a key(s), there will be an additional charge to the contractor of \$25 for each door re-cored.**

E. Document Control:

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

2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
3. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified". Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the Contracting Officer upon request.
4. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
5. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
6. Notify Contracting Officer 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-mail provided all VA encryption procedures are followed.

F. Motor Vehicle Restrictions

1. Vehicle authorization request shall be required for any vehicle entering the site and such request shall be submitted 24 hours before the date and time of access. Access shall be restricted to picking up and dropping off materials and supplies.

2. A limited number of (2 to 5) separate permits shall be issued for General Contractor and its employees for parking in designated areas only.

1.6 OPERATIONS AND STORAGE AREAS

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.
- B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.
- C. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

(FAR 52.236-10)

- D. Working space and space available for storing materials shall be as shown on the drawings and as determined by the COR.
- E. Workmen are subject to rules of Health Care System applicable to their conduct.

F. Execute work so as to interfere as little as possible with normal functioning of Health Care System as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. The Contractor shall notify the COR prior to the use of equipment and tools that transmit vibrations and noises that can be either felt or heard outside the work site. COR approval to use such equipment and tools shall be obtained in advance, not less than 48 hours prior to the use of such tools, in order to allow advance coordination with health care staff.

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

G. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown in the project drawings. In absence of such indication, in the drawings, prior to any cutting or capping, the Contractor shall coordinate cutting and capping with the COR. The Contractor shall also coordinate all such actions Utility Company involved:

1. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.
2. Contractor shall submit a request to interrupt any such services to COR, in writing, not less than 48 hours in advance of proposed

interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.

3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Health Care System. Interruption time approved by Health Care System may occur at other than Contractor's normal working hours.
4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR.
5. In case of a contract construction emergency, service will be interrupted on approval of COR. Such approval will be confirmed in writing as soon as practical.

H. 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.

I. To minimize interference of construction activities with flow of Health Care System traffic, comply with the following:

1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles.

J. Coordinate the work for this contract with other construction

operations The Contractor shall inform the COR of all such coordination. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

K. Phasing:

The Health Care System must maintain its operation 24 hours a day 7 days a week. Therefore, any interruption in service must be scheduled in advance and coordinated with the COR to ensure that no lapses in operation occur. It is the CONTRACTOR'S responsibility to develop a work plan and schedule detailing, at a minimum, the procedures to be employed, the equipment and materials to be used, the interim life safety measure to be used during the work, and a schedule defining the duration of the work with milestone subtasks. The work to be outlined shall include, but not be limited to:

To insure such executions, Contractor shall furnish the COR with a schedule of approximate phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, Contractor shall notify the COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. All phasing dates shall be arranged to insure accomplishment of this work in successive phases as detailed in the Construction Drawings for phasing.

- L. Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas to be used in the Health Care Systems operations will not be hindered. Contractor shall permit access to Department of Veterans Affairs personnel and patients through other construction areas which serve as routes of access to such affected areas and equipment. These routes whether access or egress shall be isolated from the construction

area by temporary partitions and have walking surfaces, lighting etc to facilitate patient and staff access. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Health Care System operations will continue during the construction period.

M. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2.1m (seven feet) minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Contractor shall provide hardware on the gate of the construction fence to allow exiting of the construction area freely while restricting access to patients and medical staff of the facility. VA engineering staff must have the ability to access this gate at any time. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. Removal of construction fence shall be coordinated in advance with the COR.

N. When a building and/or construction site is turned over to Contractor, Contractor shall accept entire responsibility including upkeep and maintenance therefore:

1. Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.
2. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, Contractor shall make arrangements for pre-inspection of site with Fire Department or Company (Department of Veterans Affairs or municipal) whichever will be required to respond to an alarm from Contractor's employee or watchman.

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

absence of such indication, the Contractor shall coordinate in advance with the COR and receive COR approval to proceed prior to any such cuts or caps.

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 the COR. No "HOT TAPPING" of any utility service other than storm or sanitary utilities is allowed unless under extreme circumstances. If these circumstances are determined appropriate and approved by the COR, all work must follow Facilities Management Memorandum 23 "Hot Tapping Procedures". 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 detailed work plan, the Health Care System Director's prior knowledge and written approval. Refer to specification Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, for additional requirements.
2. Contractor shall submit a request to interrupt any such services to the COR, in writing, 7 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 Health Care System. Interruption time approved by Health Care System may occur at other than Contractor's normal working hours.
4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR.
5. In case of a contract construction emergency, service will be interrupted on approval of the COR. Such approval will be confirmed in writing as soon as practical.
6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction

project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

- P. 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 at the main, branch or panel they originate from. 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.
- Q. To minimize interference of construction activities with flow of Health Care System traffic, comply with the following:
 - 1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times with approval.
 - 2. The Contractor shall submit proposed methods and scheduling of required cutting, altering and removal of existing roads, walks and entrances to the COR not less than 7 work days in advance of any such work. Plans for such work must be approved in advance by the COR.
- R. Coordinate the work for this contract with other construction operations as directed by the COR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

1.7 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR of buildings and areas of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both, to the Contracting Officer. This report shall list by rooms and spaces:

1. Existing condition and types of resilient flooring, doors, windows, walls and other surfaces not required to be altered throughout the affected areas of the buildings.
 2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, venetian blinds, shades, etc., required by drawings to be either reused or relocated, or both.
 3. Shall note any discrepancies between drawings and existing conditions at site.
 4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and COR.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of the COR, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of resilient flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:
1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:

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

1.8 DISPOSAL AND RETENTION

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

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

capacitors. The transformers and capacitors shall be taken out of service and handled in accordance with the procedures of the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) as outlined in Code of Federal Regulation (CFR), Titled 40 and 49 respectively. The EPA's Toxic Substance Control Act (TSCA) Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7 also apply. Upon removal of PCB transformers and capacitors for disposal, the "originator" copy of the Uniform Hazardous Waste Manifest (EPA Form 8700-22), along with the Uniform Hazardous Waste Manifest Continuation Sheet (EPA Form 8700-22A) shall be returned to the Contracting Officer who will annotate the contract file and transmit the Manifest to the Health Care System's Chief.

a. Copies of the following listed CFR titles may be obtained from the Government Printing Office:

40 CFR 261.....Identification and Listing of Hazardous Waste

40 CFR 262.....Standards Applicable to Generators of Hazardous Waste

40 CFR 263.....Standards Applicable to Transporters of Hazardous Waste

40 CFR 761.....PCB Manufacturing, Processing, Distribution in Commerce, and use Prohibitions

49 CFR 172.....Hazardous Material tables and Hazardous Material Communications Regulations

49 CFR 173.....Shippers - General Requirements for Shipments and Packaging

49 CFR 173.....Subpart A General

49 CFR 173.....Subpart B Preparation of Hazardous Material for Transportation

49 CFR 173.....Subpart J Other Regulated Material; Definitions and Preparation

TSCA.....Compliance Program Policy Nos. 6-PCB-6 and 6-
PCB-7

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

A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer. **Any grass that is damaged during construction will have the pre-existing grade restored, be sodded and maintained until the sod is firmly rooted as determined by the COR. Sod will be watered by contractor and may not exceed 6 inches while the contractor is responsible.**

B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

(FAR 52.236-9)

C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning

repair of damage to structures and site improvements. At a minimum, the contractor is to comply with all EPA regulations for protection from storm water pollution that would be caused by construction and implement all required safeties to maintain compliance. Also, all wash downs for concrete trucks is to be conducted off site. No containment areas are allowed on site.

D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) and/or Storm Water pollution Prevention Plan (SWPPP) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will provide the permit application upon request available at the (appropriate medical center) office. The Contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:

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

1.10 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as shown in the drawings or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without prior written approval of the CO. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.11 PHYSICAL DATA

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

(FAR 52.236-4)

- B. Subsurface conditions have been developed by core borings and test pits. Logs of subsurface exploration are shown diagrammatically on drawings.
- C. A copy of the soil report will be made available for inspection by bidders upon request to the Engineering Officer at the VA Health Care System, and shall be considered part of the contract documents.
- D. Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine site of work and logs of borings; and, after investigation, decide for themselves character of materials and make their bids accordingly. Upon proper application to Department of Veterans Affairs, bidders will be permitted to make subsurface explorations of their own at site.

1.12 PROFESSIONAL SURVEYING SERVICES

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

1.13 LAYOUT OF WORK

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

negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

(FAR 52.236-17)

- B. Establish and plainly mark center lines for each building and corner of column lines and/or addition to each existing building, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition, roads, parking lots, are in accordance with lines and elevations shown on contract drawings.
- C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:
 - 1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the COR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.
- D. During progress of work, and particularly as work progresses from floor to floor, Contractor shall have line grades and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the COR before any major items of concrete work are placed. In addition, Contractor shall also furnish to the COR certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.
 - 1. Lines of each building and/or addition.

2. Elevations of bottoms of footings and tops of floors of each building and/or addition.
3. Lines and elevations of sewers and of all outside distribution systems.

- E. Whenever changes from contract drawings are made in line or grading requiring certificates, record such changes on a reproducible drawing bearing the registered land surveyor or registered civil engineer seal, and forward these drawings upon completion of work to the COR.
- F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.14 AS-BUILT DRAWINGS

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

1.15 USE OF ROADWAYS

- A. For hauling, use only established public roads and roads on Health Care System property and, when authorized by the COR, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed and restoration performed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.
- B. When new permanent roads are to be a part of this contract, Contractor may construct them immediately for use to facilitate building

operations. These roads may be used by all who have business thereon within zone of building operations.

- C. When certain buildings (or parts of certain buildings) are required to be completed in advance of general date of completion, all roads leading thereto must be completed and available for use at time set for completion of such buildings or parts thereof.

1.16 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 written approval and compliance with the following provisions:
 - 1. Permission to use each unit or system must be given by the Contracting Officer in writing. Any such equipment shall be installed and maintained in accordance with the written agreement and following provisions
 - 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. Installation of temporary electrical equipment or devices shall be in accordance with NFPA 70, National Electrical Code, (2014 Edition), Article 590, *Temporary Installations*. Voltage supplied to each item of equipment shall be verified to be correct. Motors shall not be overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.
 - 3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be reduced to contract specifications or, in the absence of contracting specifications, to at or below manufacturer's specifications for typical installations.
 - 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.
- D. Any damage to the equipment or excessive wear due to prolonged use will be repaired replaced by the contractor at the contractor's expense.

1.17 TEMPORARY USE OF EXISTING ELEVATORS

- A. Contractor will not be allowed the use of existing elevators. Outside type hoist shall be used by Contractor for transporting materials and equipment.

1.18 TEMPORARY TOILETS

- A. Contractor may have for use of Contractor's workmen, such toilet accommodations as may be assigned to Contractor by Health Care System. Contractor shall keep such places clean **at all times** and be responsible for any damage done thereto by Contractor's workmen. Failure to maintain satisfactory condition in toilets **may result in revocation of the** Contractor's privilege to use such toilets.

1.19 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The Contractor shall carefully conserve all utilities furnished.
- B. The Contractor, at Contractor's expense and in a workmanlike manner, in compliance with code and as satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia and repair restore the infrastructure as required.
- C. Contractor shall furnish and install meters at Contractor's expense and furnish the Health Care System a monthly record of the Contractor's usage of all furnished utilities including but not limited to electricity, water and steam as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open flame devices including but not limited to 'salamander' is not permitted. Maintain minimum temperatures as specified for various materials:
 - 1. The contractor may connect to and use heat by connecting to Health Care System steam heating distribution system. Prior to utilizing this system the contractor shall ensure that the area of work is weather proof and properly insulated. Use of the facilities steam heat shall not be permitted if the area to be heated is not properly secured as aforementioned and is deemed to be wasteful of resources.
 - a. Steam is available at no cost to Contractor. Building must be dried in, insulated and deemed not wasteful of VA utilities prior to heating with steam
 - b. Electric Resistance heat is not allowed.
 - 2. If the contractor elects not to connect to the nearest available steam supply, gas/fuel heaters will be allowed with a submitted plan that is approved by the COR and facility Safety Officer.

- a. Gas/fuel heaters must be an indirect heat unit with a heat exchanger. The unit must utilize a fresh air intake and exhaust outdoors.
 - b. All gas/fuel is to be supplied by the contractor at contractor's expense.
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
 - 1. Obtain electricity by connecting to the Health Care System electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.
- F. Water (for Construction and Testing): Furnish temporary water service.
 - 1. Obtain water by connecting to the Health Care System water distribution system. Provide reduced pressure backflow preventer at each connection as per code. Water is available at no cost to the Contractor.
 - 2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR's discretion) of use of water from Health Care System's system.
 - 3. Water from the potable water system may not be used for irrigation. Irrigation water (is/is not) available near the site.
- 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 and paid by the Contractor at Contractor's expense.

1.20 NEW TELEPHONE EQUIPMENT

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

1.21 TESTS

- A. Conduct final tests required in various sections of specifications in presence of an authorized representative of the Contracting Officer. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.
- B. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonable period of time during which operating and environmental conditions remain reasonably constant and are typical of the design conditions.
- C. 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 (hard copies and electronic) and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals and one compact disc (four hard copies and one electronic copy each) for each separate piece of equipment shall be delivered to the COR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and

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

- C. Instructions: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed training to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. [Training](#) 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 [training](#) for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. The Contractor shall coordinate and schedule all [training in advance with the COR](#) COR. [Training](#) shall be considered concluded only when the COR is satisfied in regard to complete and thorough coverage. The contractor shall submit a course outline with associated material to the COR for review and approval prior to scheduling training to ensure the subject matter covers the expectations of the VA and the contractual requirements. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the COR , does not demonstrate sufficient qualifications.

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 Health Care System .

- C. Contractor shall be prepared to receive this equipment from Government and store or place such equipment not less than 90 days before Completion Date of project.
- D. Notify Contracting Officer in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.
 - 1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
 - 2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.
- E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.
- F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.
- G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

1.24 RELOCATED EQUIPMENT AND ITEMS

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated by symbol "R" or otherwise shown to be relocated by the Contractor.
- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the COR.
- C. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, at the main whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".
- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.
- E. Contractor shall employ services of an installation engineer, who is an authorized representative of the manufacturer of this equipment to supervise assembly and installation of existing equipment, required to be relocated.
- F. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

1.25 HISTORIC PRESERVATION

Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the COR verbally, and then with a written follow up. The Contractor shall cease work at the point of discovery in order to protect the find from damage, pending direction from the Contracting Officer as to how to proceed.

1.26 REBATE DOCUMENTATION

- A. As the VA is involved in rebate programs for installed materials, the contractor is to provide information to the COR including invoices, information sheets, etc. as required for the government to successfully receive rebates.

1.27 SITE INSPECTIONS

- A. The Government reserves the right to inspect the project site during contractor performance. Inspections shall conform to FAR 52.246-12 and here in described.
- B. Inspections shall be conducted randomly on a daily basis by the assigned COTR and/or other Facilities Management (FM) staff members. Once per week project sites may be inspected by Facilities Management team. Work shall commence as usual as this is a routine safety inspection.
- C. Throughout the duration of the project the contractor shall schedule critical milestone inspections and obtain approval from the Contracting Officer and COTR in order to proceed with the work.
1. Contractor shall request inspection date 10 business days prior to the proposed inspection date. The Government will make all reasonable attempts to schedule inspection within 5 business days of the proposed inspection date.
 2. At minimum the Contractor shall schedule inspections for any underground, in floor, in wall, above ceiling, concrete, concrete reinforcement, partial final and final inspection work. If any work is covered without inspection, it is the Contractor's responsibility to uncover the work at the Contractors expense for inspection.
 3. Written inspection reports will be furnished to the contractor by the Government. In the event there are discrepancies that effect follow on tasks, the Contractor shall not proceed with work without written approval from the Contracting Officer.

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

PART 1- GENERAL

1.1 DESCRIPTION:

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

1.2 CONTRACTOR'S REPRESENTATIVE:

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

1.3 CONTRACTOR'S CONSULTANT:

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

within seven calendar days from receipt of the qualification proposal. In case of disapproval, the Contractor shall resubmit another consultant within 10 calendar days for renewed consideration. The Contractor shall have their scheduling consultant approved prior to submitting any schedule for approval.

1.4 COMPUTER PRODUCED SCHEDULES

- A. The contractor shall provide monthly, to the Department of Veterans Affairs (VA), all computer-produced time/cost schedules and reports generated from monthly project updates. This monthly computer service will include: three copies of up to five different reports (inclusive of all pages) available within the user defined reports of the scheduling software approved by the Contracting Officer; a hard copy listing of all project schedule changes, and associated data, made at the update and an electronic file of this data; and the resulting monthly updated schedule in PDM format. These must be submitted with and substantively support the contractor's monthly payment request and the signed look ahead report. The COR shall identify the five different report formats that the contractor shall provide.
- B. The contractor shall be responsible for the correctness and timeliness of the computer-produced reports. The Contractor shall also 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 _____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. 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 COR. Failure to include any element of work required for the performance of this contract shall not excuse the Contractor from completing all work required within any applicable completion date of each phase regardless of the COR's approval of the Project Schedule.
- D. Compact Disk Requirements and CPM Activity/Event Record Specifications: Submit to the VA an electronic file(s) containing one file of the data required to produce a schedule, reflecting all the activities/events of the complete project schedule being submitted.

1.8 PAYMENT TO THE CONTRACTOR:

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

- B. Approval of the Contractor's monthly Application for Payment shall be contingent, among other factors, on the submittal of a satisfactory monthly update of the project schedule.

1.9 PAYMENT AND PROGRESS REPORTING

- A. Monthly schedule update meetings will be held on dates mutually agreed to by the COR and the Contractor. Contractor and their CPM consultant (if applicable) shall attend all monthly schedule update meetings. The Contractor shall accurately update the Project Schedule and all other data required and provide this information to the COR three work days in advance of the schedule update meeting. Job progress will be reviewed to verify:
 - 1. Actual start and/or finish dates for updated/completed activities/events.
 - 2. Remaining duration for each activity/event started, or scheduled to start, but not completed.
 - 3. Logic, time and cost data for change orders, and supplemental agreements that are to be incorporated into the Project Schedule.
 - 4. Changes in activity/event sequence and/or duration which have been made, pursuant to the provisions of following Article, ADJUSTMENT OF CONTRACT COMPLETION.
 - 5. Completion percentage for all completed and partially completed activities/events.
 - 6. Logic and duration revisions required by this section of the specifications.
 - 7. Activity/event duration and percent complete shall be updated independently.
- B. After completion of the joint review, the contractor shall generate an updated computer-produced calendar-dated schedule and supply the Contracting Officer's representative with reports in accordance with the Article, COMPUTER PRODUCED SCHEDULES, specified.
- C. After completing the monthly schedule update, the contractor's representative or scheduling consultant shall rerun all current period contract change(s) against the prior approved monthly project schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the contractor and resident engineer for the contract change(s). When there is a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the COR. After each rerun update, the

resulting electronic project schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.4 and 1.7. This electronic submission is separate from the regular monthly project schedule update requirements and shall be submitted to the resident engineer within fourteen (14) calendar days of completing the regular schedule update. **Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.**

- D. Following approval of the CPM schedule, the VA, the General Contractor, its approved CPM Consultant, RE office representatives, and all subcontractors needed, as determined by the SRE, shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of project schedule and to identify any necessary actions required to maintain project schedule during the reporting period. The Government representatives and the Contractor should conclude the meeting with a clear understanding of those work and administrative actions necessary to maintain project schedule status during the reporting period. This schedule coordination meeting will occur after each monthly project schedule update meeting utilizing the resulting schedule reports from that schedule update. If the project is behind schedule, discussions should include ways to prevent further slippage as well as ways to improve the project schedule status, when appropriate.

1.10 RESPONSIBILITY FOR COMPLETION

- A. If it becomes apparent from the current revised monthly progress schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:
1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
 2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.

3. Reschedule the work in conformance with the specification requirements.

- B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the COR for the proposed schedule changes. If such actions are approved, the representative schedule revisions shall be incorporated by the Contractor into the Project Schedule before the next update, at no additional cost to the Government.

1.11 CHANGES TO THE SCHEDULE

- A. Within 30 calendar days after VA acceptance and approval of any updated project schedule, the Contractor shall submit a revised electronic file (s) and a list of any activity/event changes including predecessors and successors for any of the following reasons:

1. Delay in completion of any activity/event or group of activities/events, which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the CPM as the direct cause for delaying the project beyond the acceptable limits.
2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
3. The schedule does not represent the actual prosecution and progress of the project.
4. When there is, or has been, a substantial revision to the activity/event costs regardless of the cause for these revisions.

- B. CPM revisions made under this paragraph which affect the previously approved computer-produced schedules for Government furnished equipment, vacating of areas by the VA Facility, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, shall be furnished in writing to the Contracting Officer for approval.
- C. Contracting Officer's approval for the revised project schedule and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the VA representative.
- D. The cost of revisions to the project schedule resulting from contract changes will be included in the proposal for changes in work as specified in FAR 52.243 - 4 (Changes) and VAAR 852.236 - 88 (Changes -

Supplemental), and will be based on the complexity of the revision or contract change, man hours expended in analyzing the change, and the total cost of the change.

- E. The cost of revisions to the Project Schedule not resulting from contract changes is the responsibility of the Contractor.

1.12 ADJUSTMENT OF CONTRACT COMPLETION

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

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

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

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

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

- 1-7. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.
 - 1-8. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect- Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
 - 1-9. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
- A. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
 2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
 3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.

4. Contractor shall send a copy of transmittal letter to both COR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
 5. Laboratory test reports shall be sent directly to COR for appropriate action.
 6. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
 7. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.
- D. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.
- E. Approved samples will be kept on file by the COR at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.
- F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.
1. For each drawing required, submit one legible photographic paper or vellum reproducible.
 2. Reproducible shall be full size.
 3. Each drawing shall have marked thereon, proper descriptive title, including Va HCS location, project number, manufacturer's number,

- reference to contract drawing number, detail Section Number, and Specification Section Number.
4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
 5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
 6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
 7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.
- 1-10. Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

(Architect-Engineer)

(A/E P.O. Address)

(City, State and Zip Code)

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

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**SECTION 01 35 26
SAFETY REQUIREMENTS**

TABLE OF CONTENTS

1.1	APPLICABLE PUBLICATIONS	3
1.2	DEFINITIONS	4
1.3	REGULATORY REQUIREMENTS	5
1.4	ACCIDENT PREVENTION PLAN (APP)	6
1.5	ACTIVITY HAZARD ANALYSES (AHAs)	11
1.6	PRECONSTRUCTION CONFERENCE	13
1.7	"SITE SAFETY AND HEALTH OFFICER" (SSHO) and "COMPETENT PERSON" (CP)	13
1.8	TRAINING	14
1.9	INSPECTIONS	15
1.10	ACCIDENTS, OSHA 300 LOGS, AND MAN-HOURS	16
1.11	PERSONAL PROTECTIVE EQUIPMENT (PPE)	17
1.12	INFECTION CONTROL	17
1.13	TUBERCULOSIS SCREENING	25
1.14	FIRE SAFETY	26
1.15	ELECTRICAL	29
1.16	FALL PROTECTION	30
1.17	SCAFFOLDS AND OTHER WORK PLATFORMS	31
1.18	EXCAVATION AND TRENCHES	32
1.19	CRANES	32
1.20	CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)	33
1.21	CONFINED SPACE ENTRY	33
1.22	WELDING AND CUTTING	33

1.23	LADDERS.....	34
1.24	FLOOR & WALL OPENINGS	34

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-2012Standard 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 ManualComprehensive Accreditation and Certification
Manual

G. U.S. Nuclear Regulatory Commission

10 CFR 20Standards for Protection Against Radiation

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

29 CFR 1904Reporting and Recording Injuries & Illnesses

29 CFR 1910Safety and Health Regulations for General
Industry

29 CFR 1926Safety 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

Facility Safety Officer thru the Contracting Officer's Representative (COR).

1.4 ACCIDENT PREVENTION PLAN (APP):

A. The APP (aka Construction Safety & Health Plan) shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and ensure it is site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all worksite safety and health of each subcontractor(s). Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.

B. The APP shall be prepared as follows:

1. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards pertaining to the contract (model language can be found in ASSE A10.33). Specifically articulating the safety requirements found within these VA contract safety specifications.
2. Address both the Prime Contractors and the subcontractors work operations.
3. State measures to be taken to control hazards associated with materials, services, or equipment provided by suppliers.
4. Address all the elements/sub-elements and in order as follows:
 - a. **SIGNATURE SHEET.** Title, signature, and phone number of the following:
 - 1) Plan preparer (Qualified Person such as corporate safety staff person or contracted Certified Safety Professional with construction safety experience);
 - 2) Plan approver (company/corporate officers authorized to obligate the company);

- 3) Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional). Provide concurrence of other applicable corporate and project personnel (Contractor).

b. **BACKGROUND INFORMATION.** List the following:

- 1) Contractor;
- 2) Contract number;
- 3) Project name;
- 4) Brief project description, description of work to be performed, and location; phases of work anticipated (these will require an AHA).

c. **STATEMENT OF SAFETY AND HEALTH POLICY.** Provide a copy of current corporate/company Safety and Health Policy Statement, detailing commitment to providing a safe and healthful workplace for all employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided.

d. **RESPONSIBILITIES AND LINES OF AUTHORITIES.** Provide the following:

- 1) A statement of the employer's ultimate responsibility for the implementation of his SOH program;
- 2) Identification and accountability of personnel responsible for safety at both corporate and project level. Contracts specifically requiring safety or industrial hygiene personnel shall include a copy of their resumes.
- 3) The names of Competent and/or Qualified Person(s) and proof of competency/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)

5) The Contractor's project supervisor is required to attend GEMS and Safety training provided by VA St. Cloud. Training must be attended prior to being designated as a job supervisor on any VA St. Cloud construction project.

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

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 COR:

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

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

- 1) Emergency response;
- 2) Contingency for severe weather;
- 3) Fire Prevention;
- 4) Medical Support;
- 5) Posting of emergency telephone numbers;
- 6) Prevention of alcohol and drug abuse;
- 7) Site sanitation (housekeeping, drinking water, toilets);

- 8) Night operations and lighting;
- 9) Hazard communication program;
- 10) Welding/Cutting "Hot" work;
- 11) Electrical Safe Work Practices (Electrical LOTO/NFPA 70E);
- 12) General Electrical Safety
- 13) Hazardous energy control (Machine LOTO);
- 14) Site-Specific Fall Protection & Prevention;
- 15) Excavation/trenching;
- 16) Asbestos abatement;
- 17) Lead abatement;
- 18) Crane Critical lift;
- 19) Respiratory protection;
- 20) Health hazard control program;
- 21) Radiation Safety Program;
- 22) Abrasive blasting;
- 23) Heat/Cold Stress Monitoring;
- 24) Crystalline Silica Monitoring (Assessment);
- 25) Demolition plan (to include engineering survey);
- 26) Formwork and shoring erection and removal;
- 27) PreCast Concrete.

C. Submit the APP to the COR or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 a minimum of 14 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.

- D. Once accepted by the COR the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.
- E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the COR. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34) and the environment.

1.5 ACTIVITY HAZARD ANALYSES (AHAS):

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

to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.

2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).
 - a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.
 - b. If a new Competent/Qualified Person (not on the original list) is added, the list shall be updated (an administrative action not requiring an updated AHA). The new person shall acknowledge in writing that he or she has reviewed the AHA and is familiar with current site safety issues.
3. Submit AHAs to the COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 7 calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.
4. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.
5. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. All activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier, or subcontractor and provided to the prime contractor for review and approval and then submitted to the COR.

1.6 PRECONSTRUCTION CONFERENCE:

- A. Contractor representatives who have a responsibility or significant role in implementation of the accident prevention program, as required by 29 CFR 1926.20(b)(1), on the project shall attend the preconstruction conference to gain a mutual understanding of its implementation. This includes the project superintendent, subcontractor superintendents, and any other assigned safety and health professionals.

- B. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

- C. Deficiencies in the submitted APP will be brought to the attention of the Contractor within 14 days of submittal, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

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

- A. The Prime Contractor shall designate a minimum of one SSHO at each project site that will be identified as the SSHO to administer the Contractor's safety program and government-accepted Accident Prevention Plan. Each subcontractor shall designate a minimum of one CP in compliance with 29 CFR 1926.20 (b)(2) that will be identified as a CP to administer their individual safety programs.

- B. Further, all specialized Competent Persons for the work crews will be supplied by the respective contractor as required by 29 CFR 1926 (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).

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

1.8 TRAINING:

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

trenches/excavations shall have a specialized formal course in the hazard recognition & control associated with those high hazard work operations. Documented "repeat" deficiencies in the execution of safety requirements will require retaking the requisite formal course.

- D. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course and any necessary safety training to be able to identify hazards within their work environment.
- E. Submit training records associated with the above training requirements to the COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 14 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 Resident Engineer 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 the COR.

- B. A Certified Safety Professional (CSP) with specialized knowledge in construction safety or a certified Construction Safety and Health Technician (CSHT) shall randomly conduct a monthly site safety inspection. The CSP or CSHT can be a corporate safety professional or independently contracted. The CSP or CSHT will provide their certificate number on the required report for verification as necessary.
1. Results of the inspection will be documented with tracking of the identified hazards to abatement.
 2. The COR will be notified immediately prior to start of the inspection and invited to accompany the inspection.
 3. Identified hazard and controls will be discussed to come to a mutual understanding to ensure abatement and prevent future reoccurrence.
 4. A report of the inspection findings with status of abatement will be provided to the COR within one week of the onsite inspection.

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

- A. Notify the COR as soon as practical, but no more than four hours after any accident meeting the definition of OSHA Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$5,000, or any weight handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the COR or Government Designated Authority determine whether a government investigation will be conducted.
- B. Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, and property damage accidents resulting in at least \$20,000 in damages, to establish the root cause(s) of the accident. Complete the VA Form 2162, and provide the report to the COR within 5 calendar days of the accident. The COR will provide copies of any required or special forms.

- C. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to the COR monthly.
- D. A summation of all OSHA recordable accidents experienced on site by the contractor and associated sub-contractors for each month will be provided to the COR monthly. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the COR as requested.

1.11 PERSONAL PROTECTIVE EQUIPMENT (PPE):

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

1.12 INFECTION CONTROL

- A. Infection Control is critical in all medical center facilities. Interior construction activities causing disturbance of existing dust,

or creating new dust, must be conducted within ventilation-controlled areas that minimize the flow of airborne particles into patient areas. Exterior construction activities causing disturbance of soil or creates dust in some other manner must be controlled.

- B. An AHA associated with infection control will be performed by VA personnel in accordance with FGI Guidelines (i.e. Infection Control Risk Assessment (ICRA)). The ICRA procedure found on the American Society for Healthcare Engineering (ASHE) website will be utilized. Risk classifications of Class II or lower will require approval by the COR before beginning any construction work. Risk classifications of Class III or higher will require a permit before beginning any construction work. Infection Control permits will be issued by the COR. The Infection Control Permits will be posted outside the appropriate construction area. More than one permit may be issued for a construction project if the work is located in separate areas requiring separate classes. The primary project scope area for this project is: **Class III**, 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 COR.
- 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 COR.

2. Class II requirements:

a. During Construction Work:

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

b. Upon Completion:

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

3. Class III requirements:

a. During Construction Work:

- 1) Obtain permit from the COR.
- 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, 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 COR 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 COR.

4. Class IV requirements:

a. During Construction Work:

- 1) Obtain permit from the COR.
- 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, 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 COR 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 COR.

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 Resident Engineer 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 (minimum) Two-hour (if replacing a 2 hour building separation) steel in steel frame, painted
 3. Dust proof drywall rated to existing building separation.
 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 COR and Facility CSC 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 Resident Engineer 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 the COR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. This plan may be an element of the Accident Prevention Plan.
- B. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- C. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings 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, the areas that are described in phasing requirements, and adjoining areas.
Construct partitions of gypsum board (flame spread rating of 25 or less in accordance with ASTM E84). 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 (minimum), two-hour (if replacing a 2 hour building separation) fire-rated temporary construction partitions as shown on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.
 3. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.
- 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 the COR.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to the COR.
- 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. Standpipes: Install and extend standpipes up with each floor in accordance with 29 CFR 1926 and NFPA 241. Do not charge wet standpipes subject to freezing until weather protected.
- K. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers.
- L. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with the COR. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the Resident Engineer.
- M. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with the COR.
- N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with the COR at least 8 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to the COR.
- P. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- Q. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.

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

1.15 ELECTRICAL

- A. All electrical work shall comply with NFPA 70 (NEC), NFPA 70B, NFPA 70E, 29 CFR Part 1910 Subpart J - General Environmental Controls, 29 CFR Part 1910 Subpart S - Electrical, and 29 CFR 1926 Subpart K in addition to other references required by contract.
- B. All qualified persons performing electrical work under this contract shall be licensed journeyman or master electricians. All apprentice electricians performing under this contract shall be deemed unqualified persons unless they are working under the immediate supervision of a licensed electrician or master electrician.
- C. All electrical work will be accomplished de-energized and in the Electrically Safe Work Condition (refer to NFPA 70E for Work Involving Electrical Hazards, including Exemptions to Work Permit). Any Contractor, subcontractor or temporary worker who fails to fully comply with this requirement is subject to immediate termination in accordance with FAR clause 52.236-5(c). Only in rare circumstance where achieving an electrically safe work condition prior to beginning work would increase or cause additional hazards, or is infeasible due to equipment design or operational limitations is energized work permitted. The Chief of Facilities Management with approval of the Medical Center Director will make the determination if the circumstances would meet the exception outlined above. An AHA specific to energized work activities will be developed, reviewed, and accepted prior to the start of that work.
 - 1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.
 - 2. Verification of the absence of voltage after de-energization and lockout/tagout is considered "energized electrical work" (live work)

under NFPA 70E, and shall only be performed by qualified persons wearing appropriate shock protective (voltage rated) gloves and arc rate personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.

3. Personal Protective Equipment (PPE) and electrical testing instruments will be readily available for inspection by the COR.

D. Before beginning any electrical work, an Activity Hazard Analysis (AHA) will be conducted to include Shock Hazard and Arc Flash Hazard analyses (NFPA Tables can be used only as a last alternative and it is strongly suggested a full Arc Flash Hazard Analyses be conducted). Work shall not begin until the AHA for the work activity has been accepted by the COR and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.

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

1.16 FALL PROTECTION

A. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) for ALL WORK, unless specified differently or the OSHA 29 CFR 1926 requirements are more stringent, to include steel erection activities, systems-engineered activities (prefabricated) metal buildings construction and scaffolding work.

1. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.
2. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.
3. A Warning Line System (WLS) may ONLY be used on floors or flat or low-sloped roofs (between 0 - 18.4 degrees or 4:12 slope) and shall be erected around all sides of the work area (See 29 CFR 1926.502(f) for construction of WLS requirements). Working within the WLS does

not require FP. No worker shall be allowed in the area between the roof or floor edge and the WLS without FP. FP is required when working outside the WLS.

4. Fall protection while using a ladder will be governed by the OSHA requirements.

1.17 SCAFFOLDS AND OTHER WORK PLATFORMS

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

1.18 EXCAVATION AND TRENCHES

- A. All excavation and trenching work shall comply with 29 CFR 1926 Subpart P.
- B. All excavations and trenches 5 feet in depth or greater shall require a written trenching and excavation permit (NOTE - some States and other local jurisdictions require separate state/jurisdiction-issued excavation permits). The permit shall be completed and provided to the COR prior to commencing work for the day. At the end of the day, the permit shall be closed out and provided to the COR. The permit shall be maintained onsite and include the following:
 - 1. Determination of soil classification
 - 2. Indication that utilities have been located and identified. If utilities could not be located after all reasonable attempt, then excavating operations will proceed cautiously.
 - 3. Indication of selected excavation protective system.
 - 4. Indication that the spoil pile will be stored at least 2 feet from the edge of the excavation and safe access provided within 25 feet of the workers.
 - 5. Indication of assessment for a potential toxic, explosive, or oxygen deficient atmosphere.
- C. If not using an engineered protective system such as a trench box, shielding, shoring, or other Professional Engineer designed system and using a sloping or benching system, soil classification cannot be Solid Rock or Type A. All soil will be classified as Type B or Type C and sloped or benched in accordance with Appendix B of 29 CFR 1926.

1.19 CRANES

- A. All crane work shall comply with 29 CFR 1926 Subpart CC.
- B. Prior to operating a crane, the operator must be licensed, qualified or certified to operate the crane. Thus, all the provisions contained with Subpart CC are effective and there is no "Phase In" date of November 10, 2014.

C. A detailed lift permit shall be submitted 14 days prior to the scheduled lift complete with route for truck carrying load, crane load analysis, siting of crane and path of swing. The lift will not be allowed without approval of this document.

D. Crane operators shall not carry loads

1. over the general public or VAMC personnel

2. over any occupied building unless

a. the top two floors are vacated

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

1.20 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

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 COR.

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 and Obtain permits from the COR at least 8 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 42 19
REFERENCE STANDARDS**

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

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

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

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

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

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

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

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

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

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

AIA American Institute of Architects
<http://www.aia.org>

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

GA	Gypsum Association http://www.gypsum.org
GSA	General Services Administration http://www.gsa.gov
HI	Hydraulic Institute http://www.pumps.org
HPVA	Hardwood Plywood & Veneer Association http://www.hpva.org
ICBO	International Conference of Building Officials http://www.icbo.org
ICEA	Insulated Cable Engineers Association Inc. http://www.icea.net
ICAC	Institute of Clean Air Companies http://www.icac.com
IEEE	Institute of Electrical and Electronics Engineers http://www.ieee.org
IMSA	International Municipal Signal Association http://www.imsasafety.org
IPCEA	Insulated Power Cable Engineers Association
NBMA	Metal Buildings Manufacturers Association http://www.mbma.com
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry Inc. http://www.mss-hq.com
NAAMM	National Association of Architectural Metal Manufacturers http://www.naamm.org
NAPHCC	Plumbing-Heating-Cooling Contractors Association http://www.phccweb.org.org
NBS	National Bureau of Standards See - NIST

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

NEC National Electric Code
See - NFPA National Fire Protection Association

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

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

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

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

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

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

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

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

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

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

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

PCI	Precast Prestressed Concrete Institute http://www.pci.org
PPI	The Plastic Pipe Institute http://www.plasticpipe.org
PEI	Porcelain Enamel Institute, Inc. http://www.porcelainenamel.com
PTI	Post-Tensioning Institute http://www.post-tensioning.org
RFCI	The Resilient Floor Covering Institute http://www.rfci.com
RIS	Redwood Inspection Service See - CRA
RMA	Rubber Manufacturers Association, Inc. http://www.rma.org
SCMA	Southern Cypress Manufacturers Association http://www.cypressinfo.org
SDI	Steel Door Institute http://www.steeldoor.org
IGMA	Insulating Glass Manufacturers Alliance http://www.igmaonline.org
SJI	Steel Joist Institute http://www.steeljoist.org
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association, Inc. http://www.smacna.org
SSPC	The Society for Protective Coatings http://www.sspc.org
STI	Steel Tank Institute http://www.steeltank.com

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

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

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

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

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

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

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

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

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

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained by 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/ft³ (2,700 KNm/m³))

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

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

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

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

E605-93 (R2011).....Standard Test Methods for Thickness and Density
of Sprayed Fire Resistive Material (SFRM)
Applied to Structural Members

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 the COR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of COR to such failure.

- C. Written Reports: Testing laboratory shall submit test reports to Resident Engineer, Contractor, unless other arrangements are agreed to in writing by the COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to COR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK:

- A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:
 - 1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
 - 2. Provide part time observation of fill placement and compaction and field density testing in building areas and provide part time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
 - 3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.
- B. Testing Compaction:
 - 1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D698 .
 - 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 COR before the tests are conducted.

- a. Building Slab Subgrade: At least one test of subgrade for every 185 m² (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m² (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
- b. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
- c. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
- d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
- e. Trenches: One test at maximum 30 m (100 foot) intervals per 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 Resident Engineer. 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 25 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM D422.
- 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 the COR.

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 the COR.

3.5 SITE WORK CONCRETE:

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

3.6 CONCRETE:

A. 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 m³ (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. Label each cylinder with an identification number. The COR may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (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 Resident Engineer 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.
- 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 the COR. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
 2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
 3. Furnish certified compression test reports (duplicate) to the COR. In test report, indicate the following information:
 - a. Cylinder identification number and date cast.
 - b. Specific location at which test samples were taken.
 - c. Type of concrete, slump, and percent air.
 - d. Compressive strength of concrete in MPa (psi).
 - e. Weight of lightweight structural concrete in kg/m^3 (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.

3.7 MASONRY:

A. Mortar Tests:

- 1. Laboratory compressive strength test:
 - a. Comply with ASTM C780.
 - b. Obtain samples during or immediately after discharge from batch mixer.
 - c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
 - d. Test one sample at 7 days and 2 samples at 28 days.
- 2. Two tests during first week of operation; one test per week after initial test until masonry completion.

B. Grout Tests:

- 1. Laboratory compressive strength test:
 - a. Comply with ASTM C1019.
 - b. Test one sample at 7 days and 2 samples at 28 days.
 - c. Perform test for each 230 m² (2500 square feet) of masonry.

C. Masonry Unit Tests:

- 1. Laboratory Compressive Strength Test:
 - a. Comply with ASTM C140.
 - b. Test 3 samples for each 460 m² (5000 square feet) of wall area.

- D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m² (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

3.18 TYPE OF TEST:

Approximate Number of Tests Required

A. Earthwork:

Laboratory Compaction Test, Soils: ASTM D698	1
ASTM D698)	

B. Landscaping:

Topsoil Test	1
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E. Concrete:

Making and Curing Concrete Test Cylinders (ASTM C31)	1
Compressive Strength, Test Cylinders (ASTM C39)	1
Concrete Slump Test (ASTM C143)	1
Concrete Air Content Test (ASTM C173)	1

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SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

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

7. Sanitary Wastes:

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

1.2 QUALITY CONTROL

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

1.3 REFERENCES

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

1.4 SUBMITTALS

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

proposed operations and the requirements imposed by those laws, regulations, and permits.

- f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.
- g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
- h. Permits, licenses, and the location of the solid waste disposal area.
- i. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil Conservation Service and the Department of Veterans Affairs.
- j. Environmental Monitoring Plans for the job site including land, water, air, and noise.
- k. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.

B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.5 PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.
- B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the COR. Do not fasten or attach ropes, cables, or guys to trees for

anchorage unless specifically authorized, or where special emergency use is permitted.

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

required. 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. Plan and prevent erosion of soil or sediment from entering nearby water courses or lakes.
 7. Protect adjacent areas from despoilment by temporary excavations and embankments.
 8. 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.
 9. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 10. Handle discarded materials other than those included in the solid waste category as directed by the COR.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
 2. Control movement of materials and equipment at stream crossings and in waterways 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 Minnesota and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.

1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
 2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
 3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
 4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
1. Perform construction activities involving repetitive, high-level impact noise only between 8:00 a.m. and 4:30 p.m unless otherwise permitted by local ordinance or the COR. Repetitive impact noise on the property shall not exceed the following dB limitations:

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

- a. Maintain maximum permissible construction equipment noise levels at 15 m (50 feet) (dBA):

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

- b. Use shields or other physical barriers to restrict noise transmission.
- c. Provide soundproof housings or enclosures for noise-producing machinery.
- d. Use efficient silencers on equipment air intakes.
- e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
- f. Line hoppers and storage bins with sound deadening material.
- g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
- G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.
- H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the COR. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.
- B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.
- C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycling Contractor requirements include 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. Wood (trees, tree trimmings, shrubs, etc).
 - 2. Soil.
 - 3. Inerts (eg, concrete, masonry and asphalt).
 - 4. Compostable waste (yard and non-fat food waste): biodegradable landscaping materials).
 - 5. Engineered wood products (lumber, plywood, particle board and I-joists, pallets, crates, wood furniture and furnishings, etc).
 - 6. Metal Ferrous (steel, cast iron, tine, etc).
 - 7. Metal Non-Ferrous (aluminum, brass, copper, lead and appliances, etc).
 - 8. Precious Metals (silver, gold)
 - 9. Fluorescent lamps and ballasts (one tube equals approximately 2.0 lbs)
 - 10. Electronics (computer equipment, medical equipment, etc).
 - 11. Motor Oil (one gallon equals approximately 7.5 lbs).
 - 12. Corrugated cardboard.
 - 13. Paper and fiberboard (office paper, computer paper, envelopes, colored paper and packaging, etc).
 - 14. Roofing materials.
 - 15. Plastics (containers and packaging of all types:#1 PET, #2 HDPF, #3 PVC, #4 LDPE, #5 PP, #6, PSS, #7 Other).
 - 16. Fats and greases.

- 17. Rubber (Rubber products and tires).
- 18. Glass containers.
- 19. Other glass (window panes and plate glass).
- 20. Textiles
- 21. Carpet and/or pad.
- 22. Gypsum board.
- 23. Insulation.
- 24. Paint.
- 25. Plumbing fixtures
- 26. Electrical wiring.

1.2 RELATED WORK

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

1.3 QUALITY ASSURANCE

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:
 - 1. Non-recyclable excess or unusable construction materials.
 - 2. Non-recyclable packaging used for construction products.
 - 3. Poor planning and/or layout.
 - 4. Construction error.
 - 5. Over ordering.
 - 6. Weather damage.
 - 7. Contamination.
 - 8. Mishandling.
 - 9. Breakage.
- B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.
- C. Contractor shall develop and implement procedures to reuse and recycle demolition and construction materials to a minimum of 50 percent.
- D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.

- E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website <http://www.wbdg.org> provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.
- F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials. Containers for construction and demolition debris shall be tarped unless adding or removing 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 Debris: 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 clean 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 clean inert waste, such as asphalt and concrete exclusively for the purpose of beneficial fill.
- H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or insoluble or soluble pollutants at concentrations in excess of water-

quality objectives established by a regional water board or regulatory agency, 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 Resident Engineer a written construction and 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, and protection from weather elements.
 - 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. An itemized monthly summary of construction and demolition debris diversion and disposal that includes the type, quantity, proceeds (+) or cost (-) of each material generated at the work site and disposed of or diverted from disposal through reuse or recycling.

1.6 APPLICABLE PUBLICATIONS

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

1.7 RECORDS

Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling by material type and the proceeds (+) or cost (-) for each material type; 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, tarps and storage areas to facilitate effective waste management.
- B. Clearly identify containers, bins and storage areas so that recyclable and reusable materials are separated from trash and can be transported to respective recycling or reuse facility for processing.
- C. Hazardous wastes shall be separated, labeled, stored, transported and 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 an itemized list of material types, quantities, proceeds (+) or costs (-), and 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, and invoices. Include the net total costs for each disposal.

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**SECTION 02 41 00
DEMOLITION**

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 RELATED WORK:

- A. Safety Requirements: Section 01 35 26 Safety Requirements Article, ACCIDENT PREVENTION PLAN (APP).
- B. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- E. Construction Waste Management: Section 017419 CONSTRUCTION WASTE MANAGEMENT.
- F. Infectious Control: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7, INFECTION PREVENTION MEASURES.

1.3 PROTECTION:

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it

results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.

- E. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
 - 1. No wall or part of wall shall be permitted to fall outwardly from structures.
 - 2. Maintain at least one stairway in each structure in usable condition to highest remaining floor. Keep stairway free of obstructions and debris until that level of structure has been removed.
 - 3. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
 - 4. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- F. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the VA HCS; any damaged items shall be repaired or replaced as approved by the COR. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have Resident Engineer's approval.
- H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- I. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.

1.4 UTILITY SERVICES:

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

PART 2 - PRODUCTS (NOT USED)**PART 3 - EXECUTION****3.1 DEMOLITION:**

- A. Demolish and remove selected portions of buildings and structures, including all appurtenances related or connected thereto, as noted below:
 - 1. As required for installation of new construction.
- 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 VA HCS to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COR. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- C. C. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COR. When Utility lines are encountered that are not indicated on the drawings, the COR shall be notified prior to further work in that area.

3.2 CLEAN-UP:

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

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

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 RELATED WORK:

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

1.3 TOLERANCES:

- A. ACI 117.

1.4 REGULATORY REQUIREMENTS:

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

1.5 SUBMITTALS:

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

1.6 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
 - 117-10.....Specification for Tolerances for Concrete Construction, Materials and Commentary
 - 211.1-91(R2009).....Standard Practice for Proportions for Normal, Heavyweight, and Mass Concrete
 - 301-10.....Specifications for Structural Concrete
 - 305.1-06.....Specification for Hot Weather Concreting
 - 306.1-90(R2002).....Standard Specification for Cold Weather Concreting
 - SP-66-04ACI Detailing Manual

318-11.....Building Code Requirements for Structural
Concrete and Commentary

347-04.....Guide to Formwork for Concrete

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

A615/A615M-09.....Standard Specification for Deformed and Plain
Carbon Steel Bars for Concrete Reinforcement

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

C94/C94M-12.....Standard Specification for Ready Mixed Concrete

C143/C143M-10.....Standard Test Method for Slump of Hydraulic
Cement Concrete

C150-11.....Standard Specification for Portland Cement

C171-07.....Standard Specification for Sheet Material for
Curing Concrete

C172-10.....Standard Practice for Sampling Freshly Mixed
Concrete

C173-10.....Standard Test Method for Air Content of Freshly
Mixed Concrete by the Volumetric Method

C192/C192M-07.....Standard Practice for Making and Curing
Concrete Test Specimens in the Laboratory

C231-10.....Standard Test Method for Air Content of Freshly
Mixed Concrete by the Pressure Method

C260-10.....Standard Specification for Air-Entraining
Admixtures for Concrete

C494/C494M-11.....Standard Specification for Chemical Admixtures
for Concrete

C618-12.....Standard Specification for Coal Fly Ash and Raw
or Calcined Natural Pozzolan for Use in
Concrete

D1751-04 (R2008)Standard Specification for Preformed Expansion
Joint Fillers for Concrete Paving and
Structural Construction (Non-extruding and
Resilient Bituminous Types)

D4397-10.....Standard Specification for Polyethylene
Sheeting for Construction, Industrial and
Agricultural Applications

PART 2 - PRODUCTS

2.1 FORMS:

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

2.2 MATERIALS:

- A. Portland Cement: ASTM C150, Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.
- D. Fine Aggregate: ASTM C33.
- E. Mixing Water: Fresh, clean, and potable.
- F. Air-Entraining Admixture: ASTM C260.
- G. Chemical Admixtures: ASTM C494.
- H. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil.
- I. Reinforcing Steel: ASTM A615, deformed. See structural drawings for grade.
- J. Expansion Joint Filler: ASTM D1751.
- K. Sheet Materials for Curing Concrete: ASTM C171.
- L. 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 18mpa (2500 psi) at 3 days and 35mpa (5000 psi) at 28 days.

2.3 CONCRETE MIXES:

- A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days shall be not less than 25mpa 3000 psi
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.

D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.

E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

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

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
2. Determined by Laboratory in accordance with ACI 211.1 for normal concrete.

F. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

Air content shall conform with the following table:

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

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

2.4 BATCHING & MIXING:

- A. Store, batch, and mix materials as specified in ASTM C94.
- 1. Ready-Mixed: Ready-mixed concrete comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed concrete producer shall furnish, in duplicate, certification as required by ASTM C94.

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:
 - 1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
 - 2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering

individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 REINFORCEMENT:

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

3.4 PLACING CONCRETE:

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

3.5 PROTECTION AND CURING:

Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or

cold temperature. Curing method shall be subject to approval by Resident Engineer.

3.6 FORM REMOVAL:

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

3.7 SURFACE PREPARATION:

Immediately after forms have been removed and work has been examined and approved by Resident Engineer, 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 Resident Engineer and rubbed lightly with a fine abrasive stone or hone. Use an ample amount of water during rubbing without working up a lather of mortar or changing texture of concrete.
3. Interior and Exterior Exposed Areas (finished): Finished areas, unless otherwise shown, shall be given a grout finish of uniform color and shall have a smooth finish treated as follows:
 - a. After concrete has hardened and laitance, fins and burrs have been removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone or stone.
 - b. Apply grout composed of 1 part portland cement and 1 part clean, fine sand (smaller than 600 micro-m (No. 30) sieve). Work grout into surface of concrete with cork floats or fiber brushes until all pits and honeycomb are filled.
 - c. After grout has hardened, but still plastic, remove surplus grout with a sponge rubber float and by rubbing with clean burlap.
 - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish for any area in same day. Confine

limits of finished areas to natural breaks in wall surface. Do not leave grout on concrete surface overnight.

B. Slab Finishes:

1. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.
2. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.

3.9 SURFACE TREATMENTS:

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

3.10 RESURFACING FLOORS:

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

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**SECTION 07 84 00
FIRESTOPPING**

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Provide UL or equivalent approved firestopping system for the closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction.
- B. Provide UL or equivalent approved firestopping system for the closure of openings in walls against penetration of gases or smoke in smoke partitions.

1.2 RELATED WORK:

- A. Sealants and application: Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Sustainable Design Submittals, as described below:
 - 1. Volatile organic compounds per volume as specified in
PART 2 - PRODUCTS.
- C. Installer qualifications.
- D. Inspector qualifications.
- E. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.
- F. List of FM, UL, or WH classification number of systems installed.
- G. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.
- H. Submit certificates from manufacturer attesting that firestopping materials comply with the specified requirements.

1.4 DELIVERY AND STORAGE:

- A. Deliver materials in their original unopened containers with manufacturer's name and product identification.
- B. Store in a location providing protection from damage and exposure to the elements.

1.5 QUALITY ASSURANCE:

- A. FM, UL, or WH or other approved laboratory tested products will be acceptable.
- B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991 or been evaluated by UL and found to comply

with UL's "Qualified Firestop Contractor Program Requirements." Submit qualification data.

- C. **Inspector Qualifications:** Contractor to engage a qualified inspector to perform inspections and final reports. The inspector to meet the criteria contained in ASTM E699 for agencies involved in quality assurance and to have a minimum of two years' experience in construction field inspections of firestopping systems, products, and assemblies. The inspector to be completely independent of, and divested from, the Contractor, the installer, the manufacturer, and the supplier of material or item being inspected. Submit inspector qualifications.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. **ASTM International (ASTM):**
- E84-14.....Surface Burning Characteristics of Building
Materials
- E699-09.....Standard Practice for Evaluation of Agencies
Involved in Testing, Quality Assurance, and
Evaluating of Building Components
- E814-13a.....Fire Tests of Through-Penetration Fire Stops
- E2174-14.....Standard Practice for On-Site Inspection of
Installed Firestops
- E2393-10a.....Standard Practice for On-Site Inspection of
Installed Fire Resistive Joint Systems and
Perimeter Fire Barriers
- C. **FM Global (FM):**
- Annual Issue Approval Guide Building Materials
- 4991-13.....Approval of Firestop Contractors
- D. **Underwriters Laboratories, Inc. (UL):**
- Annual Issue Building Materials Directory
- Annual Issue Fire Resistance Directory
- 723-10(2008).....Standard for Test for Surface Burning
Characteristics of Building Materials
- 1479-04(R2014).....Fire Tests of Through-Penetration Firestops
- E. **Intertek Testing Services - Warnock Hersey (ITS-WH):**
- Annual Issue Certification Listings
- F. **Environmental Protection Agency (EPA):**

40 CFR 59(2014).....National Volatile Organic Compound Emission
Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 FIRESTOP SYSTEMS:

- A. Provide either factory built (Firestop Devices) or field erected (through-Penetration Firestop Systems) to form a specific building system maintaining required integrity of the fire barrier and stop the passage of gases or smoke. Firestop systems to accommodate building movements without impairing their integrity.
- B. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 101 mm (4 in.) nominal pipe or 0.01 sq. m (16 sq. in.) in overall cross sectional area.
- C. Firestop sealants used for firestopping or smoke sealing to have the following properties:
 - 1. Contain no flammable or toxic solvents.
 - 2. Release no dangerous or flammable out gassing during the drying or curing of products.
 - 3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.
 - 4. When installed in exposed areas, capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.
 - 5. VOC Content: Firestopping sealants and sealant primers to comply with the following limits for VOC content when calculated according to 40 CFR 59, (EPA Method 24):
 - a. Sealants: 250 g/L.
 - b. Sealant Primers for Nonporous Substrates: 250 g/L.
 - c. Sealant Primers for Porous Substrates: 775 g/L.
- D. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials to have following properties:
 - 1. Classified for use with the particular type of penetrating material used.
 - 2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using firestopping

systems that allow unrestricted cable changes without damage to the seal.

- E. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84 or UL 723. Material to be an approved firestopping material as listed in UL Fire Resistance Directory or by a nationally recognized testing laboratory.
- F. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.
- G. Materials to be nontoxic and noncarcinogen at all stages of application or during fire conditions and to not contain hazardous chemicals. Provide firestop material that is free from Ethylene Glycol, PCB, MEK, and asbestos.
- H. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For floor penetrations with annular spaces exceeding 101 mm (4 in.) or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means acceptable to the firestop manufacturer.
 - 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

2.2 SMOKE STOPPING IN SMOKE PARTITIONS:

- A. Provide silicone sealant in smoke partitions as specified in Section 07 92 00, JOINT SEALANTS.
- B. Provide mineral fiber filler and bond breaker behind sealant.
- C. Sealants to have a maximum flame spread of 25 and smoke developed of 50 when tested in accordance with ASTM E84.
- D. When used in exposed areas capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Submit product data and installation instructions, as required by article, submittals, after an on-site examination of areas to receive firestopping.

- B. Examine substrates and conditions with installer present for compliance with requirements for opening configuration, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION:

- A. Remove dirt, grease, oil, laitance and form-release agents from concrete, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke stopping materials.
- B. Remove insulation on insulated pipe for a distance of 150 mm (6 inches) on each side of the fire rated assembly prior to applying the firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.
- C. Prime substrates where required by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- D. Masking Tape: Apply masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing seal of firestopping with substrates.

3.3 INSTALLATION:

- A. Do not begin firestopping work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.
- B. Install firestopping systems with smoke stopping in accordance with FM, UL, WH, or other approved system details and installation instructions.
- C. Install smoke stopping seals in smoke partitions.

3.4 CLEAN-UP:

- A. As work on each floor is completed, remove materials, litter, and debris.
- B. Clean up spills of liquid type materials.
- C. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials

approved by manufacturers of firestopping products and of products in which opening and joints occur.

- D. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to provide firestopping complying with specified requirements.

3.5 INSPECTIONS AND ACCEPTANCE OF WORK:

- A. Do not conceal or enclose firestop assemblies until inspection is complete and approved by the Contracting Officer Representative (COR).
- B. Furnish service of approved inspector to inspect firestopping in accordance with ASTM E2393 and ASTM E2174 for firestop inspection, and document inspection results. Submit written reports indicating locations of and types of penetrations and type of firestopping used at each location; type is to be recorded by UL listed printed numbers.

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**SECTION 07 92 00
JOINT SEALANTS**

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section covers interior and exterior sealant and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK (INCLUDING BUT NOT LIMITED TO THE FOLLOWING):

- A. Firestopping Penetrations: Section 07 84 00, FIRESTOPPING.

1.3 QUALITY ASSURANCE:

- A. Installer Qualifications: An experienced installer with a minimum of three (3) years' experience and who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance. Submit qualification.
- B. Source Limitations: Obtain each type of joint sealant through one (1) source from a single manufacturer.

1.4 CERTIFICATION:

- A. Contractor is to submit to the COR written certification that joints are of the proper size and design, that the materials supplied are compatible with adjacent materials and backing, that the materials will properly perform to provide permanent watertight, airtight or vapor tight seals (as applicable), and that materials supplied meet specified performance requirements.

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Sustainable Design Submittals, as described below:
 - 1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.
- C. Installer qualifications.
- D. Contractor certification.
- E. Manufacturer's installation instructions for each product used.
- F. Cured samples of exposed sealants for each color.
- G. Manufacturer's Literature and Data:
 - 1. Primers

2. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

H. Manufacturer warranty.

1.6 PROJECT CONDITIONS:

A. Environmental Limitations:

1. Do not proceed with installation of joint sealants under following conditions:

- a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C (40 degrees F).
- b. When joint substrates are wet.

B. Joint-Width Conditions:

1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions:

1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 DELIVERY, HANDLING, AND STORAGE:

- A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.
- B. Carefully handle and store to prevent inclusion of foreign materials.
- C. Do not subject to sustained temperatures exceeding 32 degrees C (90 degrees F) or less than 5 degrees C (40 degrees F).

1.8 DEFINITIONS:

- A. Definitions of terms in accordance with ASTM C717 and as specified.
- B. Backing Rod: A type of sealant backing.
- C. Bond Breakers: A type of sealant backing.
- D. Filler: A sealant backing used behind a back-up rod.

1.9 WARRANTY:

- A. Construction Warranty: Comply with FAR clause 52.246-21 "Warranty of Construction".
- B. Manufacturer Warranty: Manufacturer shall warranty their sealant for a minimum of five (5) years from the date of installation and final acceptance by the Government. Submit manufacturer warranty.

1.10 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. ASTM International (ASTM):
 - C509-06.....Elastomeric Cellular Preformed Gasket and Sealing Material
 - C612-14.....Mineral Fiber Block and Board Thermal Insulation
 - C717-14a.....Standard Terminology of Building Seals and Sealants
 - C734-06(R2012).....Test Method for Low-Temperature Flexibility of Latex Sealants after Artificial Weathering
 - C794-10.....Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
 - C919-12.....Use of Sealants in Acoustical Applications.
 - C920-14a.....Elastomeric Joint Sealants.
 - C1021-08(R2014).....Laboratories Engaged in Testing of Building Sealants
 - C1193-13.....Standard Guide for Use of Joint Sealants.
 - C1248-08(R2012).....Test Method for Staining of Porous Substrate by Joint Sealants
 - C1330-02(R2013).....Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants
 - C1521-13.....Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
 - D217-10.....Test Methods for Cone Penetration of Lubricating Grease
 - D412-06a(R2013).....Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
 - D1056-14.....Specification for Flexible Cellular Materials—Sponge or Expanded Rubber
 - E84-09.....Surface Burning Characteristics of Building Materials
- C. Sealant, Waterproofing and Restoration Institute (SWRI).
The Professionals' Guide
- D. Environmental Protection Agency (EPA):

40 CFR 59(2014).....National Volatile Organic Compound Emission
Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 SEALANTS:

A. Exterior Sealants:

1. Vertical surfaces, provide non-staining ASTM C920, Type S or M, Grade NS, Class 25, Use NT.
2. Horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T.
3. Provide location(s) of exterior sealant as follows:
 - a. Voids where items penetrate exterior walls.

B. Floor Joint Sealant:

1. ASTM C920, Type S or M, Grade P, Class 25, Use T.
2. Provide location(s) of floor joint sealant as follows.
 - a. Control and expansion joints in floors, slabs, and walkways.

C. Interior Sealants:

1. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system are to comply with the following limits for VOC content when calculated according to 40 CFR 59, (EPA Method 24):
 - a. Architectural Sealants: 250 g/L.
 - b. Sealant Primers for Nonporous Substrates: 250 g/L.
 - c. Sealant Primers for Porous Substrates: 775 g/L.
2. Vertical and Horizontal Surfaces: ASTM C920, Type S or M, Grade NS, Class 25, Use NT.
3. Provide location(s) of interior sealant as follows:
 - a. Typical narrow joint 6 mm, (1/4 inch) or less at walls and adjacent components.
 - b. Interior surfaces of exterior wall penetrations.
 - c. New penetrations of electrical and mechanical equipment at non-fire-rated walls and partitions.

D. Acoustical Sealant:

1. Conforming to ASTM C919; flame spread of 25 or less; and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Acoustical sealant have a consistency of 250 to 310 when tested in accordance with ASTM D217; remain flexible and adhesive

after 500 hours of accelerated weathering as specified in ASTM C734; and be non-staining.

2. Provide location(s) of acoustical sealant as follows:
 - a. Exposed acoustical joint at sound rated partitions.
 - b. Concealed acoustic joints at sound rated partitions.
 - c. Joints where item pass-through sound rated partitions.

2.2 COLOR:

- A. Sealants used with exposed masonry are to match color of mortar joints.
- B. Sealants used with unpainted concrete are to match color of adjacent concrete.
- C. Color of sealants for other locations to be light gray or aluminum, unless otherwise indicated in construction documents.

2.3 JOINT SEALANT BACKING:

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056 or synthetic rubber (ASTM C509), nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32 degrees C (minus 26 degrees F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 FILLER:

- A. Mineral fiberboard: ASTM C612, Class 1.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

2.5 PRIMER:

- A. As recommended by manufacturer of caulking or sealant material.
- B. Stain free type.

2.6 CLEANERS-NON POROUS SURFACES:

- A. Chemical cleaners compatible with sealant and acceptable to manufacturer of sealants and sealant backing material. Cleaners to be free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 - EXECUTION**3.1 INSPECTION:**

- A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.
- B. Coordinate for repair and resolution of unsound substrate materials.
- C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 PREPARATIONS:

- A. Prepare joints in accordance with manufacturer's instructions and SWRI (The Professionals' Guide).
- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
 - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
 - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include but are not limited to the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of

interfering with adhesion of joint sealants. Nonporous surfaces include but are not limited to the following:

- a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply non-staining masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
- 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions or as indicated by pre-construction joint sealant substrate test.
- 1. Apply primer prior to installation of back-up rod or bond breaker tape.
 - 2. Use brush or other approved means that will reach all parts of joints. Avoid application to or spillage onto adjacent substrate surfaces.

3.3 BACKING INSTALLATION:

- A. Install backing material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the backing rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of backing rod and sealants.
- D. Install backing rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
- E. Where space for backing rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.

3.4 SEALANT DEPTHS AND GEOMETRY:

- A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.

- B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.5 INSTALLATION:

A. General:

1. Apply sealants and caulking only when ambient temperature is between 5 degrees C and 38 degrees C (40 degrees and 100 degrees F).
 2. Do not install polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
 3. Do not install sealant type listed by manufacture as not suitable for use in locations specified.
 4. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
 5. Avoid dropping or smearing compound on adjacent surfaces.
 6. Fill joints solidly with compound and finish compound smooth.
 7. Tool exposed joints to form smooth and uniform beds, with slightly concave surface conforming to joint configuration per Figure 5A in ASTM C1193 unless shown or specified otherwise in construction documents. Remove masking tape immediately after tooling of sealant and before sealant face starts to "skin" over. Remove any excess sealant from adjacent surfaces of joint, leaving the working in a clean finished condition.
 8. Finish paving or floor joints flush unless joint is otherwise detailed.
 9. Apply compounds with nozzle size to fit joint width.
 10. Test sealants for compatibility with each other and substrate. Use only compatible sealant. Submit test reports.
 11. Replace sealant which is damaged during construction process.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise. Take all necessary steps to prevent three-sided adhesion of sealants.
 - C. Interior Sealants: Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.

1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cutouts to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.6 FIELD QUALITY CONTROL:

- A. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements.
- B. Remove and replace any sealants that do not comply with the specifications. Do not new sealant over existing sealant.

3.7 CLEANING:

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by manufacturer of the adjacent material or if not otherwise indicated by the caulking or sealant manufacturer.
- B. Leave adjacent surfaces in a clean and unstained condition.

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SECTION 09 91 00
PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the painting and finishing as shown on the construction documents and/or specified herein, including, but not limited to, the following:
1. Prime coats which may be applied in shop under other sections.
 2. Prime painting unprimed surfaces to be painted under this Section.
 3. Painting items furnished with a prime coat of paint, including touching up of or repairing of abraded, damaged or rusted prime coats applied by others.
 4. Painting ferrous metal (except stainless steel) exposed to view.
 5. Painting galvanized ferrous metals exposed to view.
 6. Painting interior concrete block exposed to view.
 7. Painting gypsum drywall exposed to view.
 8. Painting of wood exposed to view, except items which are specified to be painted or finished under other Sections of these specifications. Back painting of all wood in contact with concrete, masonry or other moisture areas.
 9. Painting pipes, pipe coverings, conduit, ducts, insulation, hangers, supports and other mechanical and electrical items and equipment exposed to view.
 10. Painting surfaces above, behind or below grilles, gratings, diffusers, louvers lighting fixtures, and the like, which are exposed to view through these items.
 11. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.
 12. Incidental painting and touching up as required to produce proper finish for painted surfaces, including touching up of factory finished items.
 13. Painting of any surface not specifically mentioned to be painted herein or on construction documents, but for which painting is obviously necessary to complete the job, or work which comes within the intent of these specifications, is to be included as though specified.

1.2 RELATED WORK:

- A. Activity Hazard Analysis: Section 01 35 26, SAFETY REQUIREMENTS.
- B. Shop prime painting of steel and ferrous metals: Division 05 - METALS; Division 21 - FIRE SUPPRESSION; Division 23 - HEATING; VENTILATION AND AIR-CONDITIONING; Division 26 - ELECTRICAL; and Division 27 - COMMUNICATIONS sections.

1.3 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Sustainable Design Submittals as described below:
 - 1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS
- C. Painter qualifications.
- D. Manufacturer's Literature and Data:
 - 1. Before work is started, or sample panels are prepared, submit manufacturer's literature and technical data, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one (1) list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.
- E. Sample Panels:
 - 1. After painters' materials have been approved and before work is started submit sample panels showing each type of finish and color specified.
 - 2. Panels to Show Color: Composition board, 100 x 250 mm (4 x 10 inch).
 - 3. Panel to Show Transparent Finishes: Wood of same species and grain pattern as wood approved for use, 100 x 250 mm (4 x 10 inch face) minimum, and where both flat and edge grain will be exposed, 250 mm (10 inches) long by sufficient size, 50 x 50 mm (2 x 2 inch) minimum or actual wood member to show complete finish.
 - 4. Attach labels to panel stating the following:
 - a. Federal Specification Number or manufacturers name and product number of paints used.
 - b. Product type and color.
 - c. Name of project.

5. Strips showing not less than 50 mm (2 inch) wide strips of undercoats and 100 mm (4 inch) wide strip of finish coat.

F. Sample of identity markers if used.

G. Manufacturers' Certificates indicating compliance with specified requirements:

1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.

1.4 DELIVERY AND STORAGE:

A. Deliver materials to site in manufacturer's sealed container marked to show following:

1. Name of manufacturer.
2. Product type.
3. Batch number.
4. Instructions for use.
5. Safety precautions.

B. In addition to manufacturer's label, provide a label legibly printed as following:

1. Federal Specification Number, where applicable, and name of material.
2. Surface upon which material is to be applied.
3. Specify Coat Types: Prime; body; finish; etc.

C. Maintain space for storage, and handling of painting materials and equipment in a ventilated, neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.

D. Store materials at site at least 24 hours before using, at a temperature between 7 and 30 degrees C (45 and 85 degrees F).

1.5 QUALITY ASSURANCE:

A. Qualification of Painters: Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces. Submit evidence that key personnel have successfully performed surface preparation and application of coating on a minimum of three (3) similar projects within the past three (3) years.

B. Paint Coordination: Provide finish coats which are compatible with the prime paints used. Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. Upon request from other subcontractors, furnish information on the characteristics of the finish materials proposed to be used, to ensure that compatible prime coats are

used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify the Contracting Officer Representative (COR) in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

1.6 REGULATORY REQUIREMENTS:

- A. Paint materials are to conform to the restrictions of the local Environmental and Toxic Control jurisdiction.
 - 1. Volatile Organic Compounds (VOC) Emissions Requirements: Field-applied paints and coatings that are inside the waterproofing system to not exceed limits of authorities having jurisdiction.
 - 2. Lead-Base Paint:
 - a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
 - b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
 - c. Do not use coatings having a lead content over 0.06 percent by weight of non-volatile content.
 - 3. Asbestos: Provide materials that do not contain asbestos.
 - 4. Chromate, Cadmium, Mercury, and Silica: Provide materials that do not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
 - 5. Human Carcinogens: Provide materials that do not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
 - 6. Use high performance acrylic paints in place of alkyd paints.

1.7 SAFETY AND HEALTH

- A. Apply paint materials using safety methods and equipment in accordance with the following:
 - 1. Comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis (AHA) as specified in Section 01 35 26, SAFETY REQUIREMENTS. The AHA is to include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

- B. Safety Methods Used During Paint Application: Comply with the requirements of SSPC PA Guide 10.
- C. Toxic Materials: To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:
 - 1. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.
 - 2. 29 CFR 1910.1000.
 - 3. ACHIH-BKLT and ACGIH-DOC, threshold limit values.

1.8 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. American Conference of Governmental Industrial Hygienists (ACGIH):
 - ACGIH TLV-BKLT-2012.....Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
 - ACGIH TLV-DOC-2012.....Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)
- C. ASME International (ASME):
 - A13.1-07(R2013).....Scheme for the Identification of Piping Systems
- D. Code of Federal Regulation (CFR):
 - 40 CFR 59.....Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating
- E. Commercial Item Description (CID):
 - A-A-1272A.....Plaster Gypsum (Spackling Compound)
- F. Federal Specifications (Fed Spec):
 - TT-P-1411A.....Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)
- G. Master Painters Institute (MPI):
 - 1.....Aluminum Paint
 - 4.....Interior/ Exterior Latex Block Filler
 - 5.....Exterior Alkyd Wood Primer
 - 7.....Exterior Oil Wood Primer
 - 8.....Exterior Alkyd, Flat MPI Gloss Level 1
 - 9.....Exterior Alkyd Enamel MPI Gloss Level 6
 - 10.....Exterior Latex, Flat
 - 11.....Exterior Latex, Semi-Gloss

- | | |
|----------|--|
| 18..... | Organic Zinc Rich Primer |
| 22..... | Aluminum Paint, High Heat (up to 590° - 1100F) |
| 27..... | Exterior / Interior Alkyd Floor Enamel, Gloss |
| 31..... | Polyurethane, Moisture Cured, Clear Gloss |
| 36..... | Knot Sealer |
| 43..... | Interior Satin Latex, MPI Gloss Level 4 |
| 44..... | Interior Low Sheen Latex, MPI Gloss Level 2 |
| 45..... | Interior Primer Sealer |
| 46..... | Interior Enamel Undercoat |
| 47..... | Interior Alkyd, Semi-Gloss, MPI Gloss Level 5 |
| 48..... | Interior Alkyd, Gloss, MPI Gloss Level 6 |
| 50..... | Interior Latex Primer Sealer |
| 51..... | Interior Alkyd, Eggshell, MPI Gloss Level 3 |
| 52..... | Interior Latex, MPI Gloss Level 3 |
| 53..... | Interior Latex, Flat, MPI Gloss Level 1 |
| 54..... | Interior Latex, Semi-Gloss, MPI Gloss Level 5 |
| 59..... | Interior/Exterior Alkyd Porch & Floor Enamel, Low Gloss |
| 60..... | Interior/Exterior Latex Porch & Floor Paint, Low Gloss |
| 66..... | Interior Alkyd Fire Retardant, Clear Top-Coat (ULC Approved) |
| 67..... | Interior Latex Fire Retardant, Top-Coat (ULC Approved) |
| 68..... | Interior/ Exterior Latex Porch & Floor Paint, Gloss |
| 71..... | Polyurethane, Moisture Cured, Clear, Flat |
| 77..... | Epoxy Cold Cured, Gloss |
| 79..... | Marine Alkyd Metal Primer |
| 90..... | Interior Wood Stain, Semi-Transparent |
| 91..... | Wood Filler Paste |
| 94..... | Exterior Alkyd, Semi-Gloss |
| 95..... | Fast Drying Metal Primer |
| 98..... | High Build Epoxy Coating |
| 101..... | Epoxy Anti-Corrosive Metal Primer |
| 108..... | High Build Epoxy Coating, Low Gloss |
| 114..... | Interior Latex, Gloss |
| 119..... | Exterior Latex, High Gloss (acrylic) |

- 134.....Galvanized Water Based Primer
- 135.....Non-Cementitious Galvanized Primer
- 138.....Interior High Performance Latex, MPI Gloss Level 2
- 139.....Interior High Performance Latex, MPI Gloss Level 3
- 140.....Interior High Performance Latex, MPI Gloss Level 4
- 141.....Interior High Performance Latex (SG) MPI Gloss
Level 5
- 163.....Exterior Water Based Semi-Gloss Light Industrial
Coating, MPI Gloss Level 5

G. Society for Protective Coatings (SSPC):

- SSPC SP 1-82(R2004).....Solvent Cleaning
- SSPC SP 2-82(R2004).....Hand Tool Cleaning
- SSPC SP 3-28(R2004).....Power Tool Cleaning
- SSPC SP 10/NACE No.2.....Near-White Blast Cleaning
- SSPC PA Guide 10.....Guide to Safety and Health Requirements

H. Maple Flooring Manufacturer's Association (MFMA):

I. U.S. National Archives and Records Administration (NARA):

- 29 CFR 1910.1000.....Air Contaminants

J. Underwriter's Laboratory (UL)

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Conform to the coating specifications and standards referenced in PART 3.
Submit manufacturer's technical data sheets for specified coatings and solvents.

2.2 PAINT PROPERTIES:

- A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.
- B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.
- C. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only to recommended limits.
- D. VOC Content: For field applications that are inside the weatherproofing system, paints and coating to comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Non-flat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

E. VOC test method for paints and coatings is to be in accordance with 40 CFR 59 (EPA Method 24). Part 60, Appendix A with the exempt compounds' content determined by Method 303 (Determination of Exempt Compounds) in the South Coast Air Quality Management District's (SCAQMD) "Laboratory Methods of Analysis for Enforcement Samples" manual.

2.3 PLASTIC TAPE:

- A. Pigmented vinyl plastic film in colors as specified
- B. Pressure sensitive adhesive back.
- C. Widths as shown on construction documents.

PART 3 - EXECUTION

3.1 JOB CONDITIONS:

- A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
 1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
 2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each day's work.
- B. Atmospheric and Surface Conditions:
 1. Do not apply coating when air or substrate conditions are:
 - a. Less than 3 degrees C (5 degrees F) above dew point.
 - b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the COR and the product manufacturer. Under no circumstances are application conditions to exceed manufacturer recommendations.
 - c. When the relative humidity exceeds 85 percent; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.

2. Maintain interior temperatures until paint dries hard.
3. Do no exterior painting when it is windy and dusty.
4. Do not paint in direct sunlight or on surfaces that the sun will warm.
5. Apply only on clean, dry and frost free surfaces except as follows:
 - a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces only when allowed by manufacturer's printed instructions.
 - b. Concrete and masonry when permitted by manufacturer's recommendations, dampen surfaces to which water thinned acrylic and cementitious paints are applied with a fine mist of water on hot dry days to prevent excessive suction and to cool surface.
6. Varnishing:
 - a. Apply in clean areas and in still air.
 - b. Before varnishing vacuum and dust area.
 - c. Immediately before varnishing wipe down surfaces with a tack rag.

3.2 INSPECTION:

- A. Examine the areas and conditions where painting and finishing are to be applied and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.3 GENERAL WORKMANSHIP REQUIREMENTS:

- A. Application may be by brush or roller. Spray application only upon acceptance from the COR in writing.
- B. Furnish to the COR a painting schedule indicating when the respective coats of paint for the various areas and surfaces will be completed. This schedule is to be kept current as the job progresses.
- C. Protect work at all times. Protect all adjacent work and materials by suitable covering or other method during progress of work. Upon completion of the work, remove all paint and varnish spots from floors, glass and other surfaces. Remove from the premises all rubbish and accumulated materials of whatever nature not caused by others and leave work in a clean condition.
- D. Remove and protect hardware, accessories, device plates, lighting fixtures, and factory finished work, and similar items, or provide in place protection. Upon completion of each space, carefully replace all removed items by workmen skilled in the trades involved.

- E. When indicated to be painted, remove electrical panel box covers and doors before painting walls. Paint separately and re-install after all paint is dry.
- F. Materials are to be applied under adequate illumination, evenly spread and flowed on smoothly to avoid runs, sags, holidays, brush marks, air bubbles and excessive roller stipple.
- G. Apply materials with a coverage to hide substrate completely. When color, stain, dirt or undercoats show through final coat of paint, the surface is to be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage, at no additional cost to the Government.
- H. All coats are to be dry to manufacturer's recommendations before applying succeeding coats.
- I. All suction spots or "hot spots" in plaster after the application of the first coat are to be touched up before applying the second coat.
- J. Do not apply paint behind frameless mirrors that use mastic for adhering to wall surface.

3.4 SURFACE PREPARATION:

A. General:

1. The Contractor shall be held wholly responsible for the finished appearance and satisfactory completion of painting work. Properly prepare all surfaces to receive paint, which includes cleaning, sanding, and touching-up of all prime coats applied under other Sections of the work. Broom clean all spaces before painting is started. All surfaces to be painted or finished are to be completely dry, clean and smooth.
2. See other sections of specifications for specified surface conditions and prime coat.
3. Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.
4. Clean surfaces before applying paint or surface treatments with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry. Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.

5. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

- a. Concrete: 12 percent.
- b. Fiber-Cement Board: 12 percent.
- c. Masonry (Clay and CMU's): 12 percent.
- d. Wood: 15 percent.
- e. Gypsum Board: 12 percent.
- f. Plaster: 12 percent.

B. Wood:

- 1. Sand to a smooth even surface and then dust off.
- 2. Sand surfaces showing raised grain smooth between each coat.
- 3. Wipe surface with a tack rag prior to applying finish.
- 4. Surface painted with an opaque finish:
 - a. Coat knots, sap and pitch streaks with MPI 36 (Knot Sealer) before applying paint.
 - b. Apply two coats of MPI 36 (Knot Sealer) over large knots.
- 5. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with wood filler paste. Sand the surface to make smooth and finish flush with adjacent surface.
- 6. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.
- 7. Fill open grained wood such as oak, walnut, ash and mahogany with MPI 91 (Wood Filler Paste), colored to match wood color.
 - a. Thin filler in accordance with manufacturer's instructions for application.
 - b. Remove excess filler, wipe as clean as possible, dry, and sand as specified.

C. Ferrous Metals:

- 1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
- 2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning).
- 3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel

- doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
- a. Fill flat head countersunk screws used for permanent anchors.
 - b. Do not fill screws of item intended for removal such as glazing beads.
4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
 5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.
- D. Zinc-Coated (Galvanized) Metal Surfaces Specified Painted:
1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion in accordance with SSPC-SP 1 (Solvent Cleaning).
 2. Spot coat abraded and damaged areas of zinc-coating which expose base metal on hot-dip zinc-coated items with MPI 18 (Organic Zinc Rich Coating). Prime or spot prime with MPI 134 (Waterborne Galvanized Primer) or MPI 135 (Non-Cementitious Galvanized Primer) depending on finish coat compatibility.
- E. Masonry and Cement Plaster:
1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.
 2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
 3. Remove loose mortar in masonry work.
 4. Replace mortar and fill open joints, holes, cracks and depressions with new mortar. Finish to match adjacent surfaces.
- F. Gypsum Plaster and Gypsum Board:
1. Remove efflorescence, loose and chalking plaster or finishing materials.
 2. Remove dust, dirt, and other deterrents to paint adhesion.
 3. Fill holes, cracks, and other depressions with CID-A-A-1272A finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

3.5 PAINT PREPARATION:

- A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.

- B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
- C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.
- D. Mix two (2) component and two (2) part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
- E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.6 APPLICATION:

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
- B. Unless otherwise specified, apply paint in three (3) coats; prime, body, and finish. When two (2) coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
- C. Apply each coat evenly and cover substrate completely.
- D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by COR.
- E. Apply by brush or roller. Spray application for new or existing occupied spaces only upon approval by acceptance from COR in writing.
 - 1. Apply painting materials specifically required by manufacturer to be applied by spraying.
 - 2. In new construction and in existing occupied spaces, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in "Building and Structural Work Field Painting"; "Work not Painted"; motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.
- F. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.7 PRIME PAINTING:

- A. After surface preparation, prime surfaces before application of body and finish coats, except as otherwise specified.

- B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.
- C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.
- D. Prime rabbets for stop and face glazing of wood, and for face glazing of steel.
- E. Wood and Wood Particleboard:
 - 1. Use same kind of primer specified for exposed face surface.
 - a. Exterior wood: MPI 7 (Exterior Oil Wood Primer) for new construction and MPI 5 (Exterior Alkyd Wood Primer) for repainting bare wood primer except where MPI 90 (Interior Wood Stain, Semi-Transparent) is scheduled.
 - b. Interior wood except for transparent finish: MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat), thinned if recommended by manufacturer.
 - c. Transparent finishes as specified under "Transparent Finishes on Wood Except Floors Article".
 - 2. Apply two (2) coats of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) to surfaces of wood doors, including top and bottom edges, which are cut for fitting or for other reason.
 - 3. Apply one (1) coat of primer MPI 7 (Exterior Oil Wood Primer) or MPI 5 (Exterior Alkyd Wood Primer) or sealer MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) as soon as delivered to site to surfaces of unfinished woodwork, except concealed surfaces of shop fabricated or assembled millwork and surfaces specified to have varnish, stain or natural finish.
 - 4. Back prime and seal ends of exterior woodwork, and edges of exterior plywood specified to be finished.
 - 5. Apply MPI 67 (Interior Latex Fire Retardant, Top-Coat (UL Approved) to wood for fire retardant finish.
- F. Metals except boilers, incinerator stacks, and engine exhaust pipes:
 - 1. Steel and iron: MPI 95 (Fast Drying Metal Primer).
 - 2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer) .

G. Gypsum Board:

1. Surfaces scheduled to have MPI 11 (Exterior Latex, Semi-Gloss, AE) .
2. Primer: MPI 50 (Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer) in shower and bathrooms.

H. Gypsum Plaster and Veneer Plaster:

1. Surfaces scheduled to receive vinyl coated fabric wall covering: Use MPI 45 (Interior Primer Sealer).
2. MPI 45 (Interior Primer Sealer), except use MPI 50 (Interior Latex Primer Sealer) when an alkyd flat finish is specified.
3. Surfaces scheduled to have MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5) finish: Use MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5).

I. Concrete Masonry Units except glazed or integrally colored and decorative units:

1. MPI 4 (Block Filler) on interior surfaces.
 - a. Benjamin Moore; Eco Spec Latex Block Filler 160.
 - b. Benjamin Moore; Super Spec Latex Block Filler 160.
 - c. Benjamin Moore; Super Spec Masonry Latex Block Filler 206.
2. Prime exterior surface as specified for exterior finishes.

J. Cement Plaster or stucco, Concrete Masonry, Brick Masonry Interior Surfaces of Walls:

1. MPI 53 (Interior Latex, Flat, MPI Gloss Level 1)
1. .

3.9 INTERIOR FINISHES:

A. Apply following finish coats over prime coats in spaces or on surfaces indicated on the Room Finish Schedule.

B. Metal Work:

1. Apply to exposed surfaces.
2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
 - a. Apply two (2) coats of MPI 47 (Interior Alkyd, Semi-Gloss) unless specified otherwise.

C. Gypsum Board:

1. One (1) coat of MPI 45 (Interior Primer Sealer) plus one (1) coat of MPI 139 (Interior High Performance Latex, MPI Gloss level 3).

D. Plaster:

1. One (1) coat of MPI 45 (Interior Primer Sealer) plus one (1) coat of MPI 139 (Interior High Performance Latex, MPI Gloss level 3).

E. Masonry and Concrete Walls:

1. Over MPI 4 (Interior/Exterior Latex Block Filler) on CMU surfaces.
2. Two (2) coats of MPI 53 (Interior Latex, Flat, MPI Gloss Level 1)

F. Wood:

1. Sanding:

- a. Use 220-grit sandpaper.
- b. Sand sealers and varnish between coats.
- c. Sand enough to scarify surface to assure good adhesion of subsequent coats, to level roughly applied sealer and varnish, and to knock off "whiskers" of any raised grain as well as dust particles.

2. Sealers:

- a. MPI 31 (gloss) or MPI 71 (flat) thinned as recommended by manufacturer at rate of one (1) part of thinner to four (4) parts of varnish.
- b. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.
- c. Allow manufacturer's recommended drying time before sanding, but not less than 24 hours or 36 hours in damp or muggy weather.
- d. Sand as specified.

3. Paint Finish:

- a. One (1) coat of MPI 45 (Interior Primer Sealer) plus one (1) coat of MPI 47 (Interior Alkyd, Semi-Gloss).

4. Transparent Finishes on Wood Except Floors.

a. Natural Finish:

- 1) One (1) coat of sealer MPI 71 (flat) thinned with thinner recommended by manufacturer at rate of one (1) part of thinner to four (4) parts of varnish.

b. Stain Finish:

- 1) One (1) coat of MPI 90 (Interior Wood Stain, Semi-Transparent).
- 2) Use wood stain of type and color required to achieve finish specified. Do not use varnish type stains.
- 3) Polyurethane Moisture Cured, Clear Gloss).

G. Miscellaneous:

1. MPI 1 (Aluminum Paint): Two (2) coats of aluminum paint.

3.10 REFINISHING EXISTING PAINTED SURFACES:

- A. Clean, patch and repair existing surfaces as specified under "Surface Preparation". No "telegraphing" of lines, ridges, flakes, etc., through new surfacing is permitted. Where this occurs, sand smooth and re-finish until surface meets with COR's approval.
- B. Remove and reinstall items as specified under "General Workmanship Requirements".
- C. Remove existing finishes or apply separation coats to prevent non compatible coatings from having contact.
- D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.
- E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.
- F. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one (1) coat of MPI 71 (Polyurethane, Moisture Cured, Clear Flat).
- G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.
- H. Coat knots and pitch streaks showing through old finish with MPI 36 (Knot Sealer) before refinishing.
- I. Sand or dull glossy surfaces prior to painting.
- J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.11 PAINT COLOR:

- A. For additional requirements regarding color see Articles, "REFINISHING EXISTING PAINTED SURFACE" and "MECHANICAL AND ELECTRICAL FIELD PAINTING SCHEDULE".
- B. Coat Colors:
 1. Color of priming coat: Lighter than body coat.
 2. Color of body coat: Lighter than finish coat.
 3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.
- C. Painting, Caulking, Closures, and Fillers Adjacent to Casework:
 1. Paint to match color of casework where casework has a paint finish.

2. Paint to match color of wall where casework is stainless steel, plastic laminate, or varnished wood.

3.12 MECHANICAL AND ELECTRICAL WORK FIELD PAINTING SCHEDULE:

- A. Field painting of mechanical and electrical consists of cleaning, touching-up abraded shop prime coats, and applying prime, body and finish coats to materials and equipment if not factory finished in space scheduled to be finished.
- B. Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, and Division 27 - COMMUNICATIONS.
- C. Paint after tests have been completed.
- D. Omit prime coat from factory prime-coated items.
- E. Finish painting of mechanical and electrical equipment is not required when located in interstitial spaces, above suspended ceilings, in concealed areas such as pipe and electric closets, pipe basements, pipe tunnels, trenches, attics, roof spaces, shafts and furred spaces except on electrical conduit containing feeders 600 volts or more.
- F. Omit field painting of items specified in "BUILDING AND STRUCTURAL WORK FIELD PAINTING"; "Building and Structural Work not Painted".
- G. Color:
 1. Paint items having no color specified in SCHEDULE FOR FINISHES to match surrounding surfaces.
 2. Paint colors as specified in SCHEDULE FOR FINISHES except for following:
 - a. White: Exterior unfinished surfaces of enameled plumbing fixtures. Insulation coverings on breeching and uptake inside boiler house, drums and drum-heads, oil heaters, condensate tanks and condensate piping.
 - b. Gray: Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces), and water and sewage treatment equipment and sewage ejection equipment.
 - c. Aluminum Color: Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment, and steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).

- d. Federal Safety Red: Exposed fire protection piping hydrants, post indicators, electrical conducts containing fire alarm control wiring, and fire alarm equipment.
 - e. Federal Safety Orange: Entire lengths of electrical conduits containing feeders 600 volts or more.
 - f. Color to match brickwork sheet metal covering on breeching outside of exterior wall of boiler house.
- H. Apply paint systems on properly prepared and primed surface as follows:
- 1. Interior Locations:
 - a. Apply two (2) coats of MPI 47 (Interior Alkyd, Semi-Gloss) to following items:
 - 1) Metal under 94 degrees C (201 degrees F) of items such as bare piping, fittings, hangers and supports.
 - 2) Equipment and systems such as hinged covers and frames for control cabinets and boxes, cast-iron radiators, electric conduits and panel boards.
 - 3) Heating, ventilating, air conditioning, plumbing equipment, and machinery having shop prime coat and not factory finished.
 - 3. Other exposed locations:
 - a. Metal surfaces, except aluminum, of cooling towers exposed to view, including connected pipes, rails, and ladders: Two (2) coats of MPI 1 (Aluminum Paint).

3.13 BUILDING AND STRUCTURAL WORK FIELD PAINTING:

- A. Painting and finishing of interior and exterior work except as specified here-in-after.
 - 1. Painting and finishing of new and existing work including colors and gloss of finish selected is specified in Finish Schedule.
 - 2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
 - 3. Painting of ferrous metal and galvanized metal.
 - 4. Painting of wood with fire retardant paint exposed in attics, when used as mechanical equipment space (except shingles).
 - 5. Identity painting and safety painting.

B. Building and Structural Work not Painted:

1. Prefinished items:

- a. Casework, doors, elevator entrances and cabs, metal panels, wall covering, and similar items specified factory finished under other sections.
- b. Factory finished equipment and pre-engineered metal building components such as metal roof and wall panels.

2. Finished surfaces:

- a. Hardware except ferrous metal.
- b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as otherwise specified.
- c. Signs, fixtures, and other similar items integrally finished.

3. Concealed surfaces:

- a. Inside dumbwaiter, elevator and duct shafts, interstitial spaces, pipe basements, crawl spaces, pipe tunnels, above ceilings, attics, except as otherwise specified.
- b. Inside walls or other spaces behind access doors or panels.
- c. Surfaces concealed behind permanently installed casework and equipment.

4. Moving and operating parts:

- a. Shafts, chains, gears, mechanical and electrical operators, linkages, and sprinkler heads, and sensing devices.
- b. Tracks for overhead or coiling doors, shutters, and grilles.

5. Labels:

- a. Code required label, such as Underwriters Laboratories Inc., Intertek Testing Service or Factory Mutual Research Corporation.
- b. Identification plates, instruction plates, performance rating, and nomenclature.

6. Galvanized metal:

- a. Exterior chain link fence and gates, corrugated metal areaways, and gratings.
- b. Gas Storage Racks.
- c. Except where specifically specified to be painted.

7. Metal safety treads and nosings.

8. Gaskets.

9. Concrete curbs, gutters, pavements, retaining walls, exterior exposed foundations walls and interior walls in pipe basements.

10. Face brick.

11. Structural steel encased in concrete, masonry, or other enclosure.
12. Structural steel to receive sprayed-on fire proofing.
13. Ceilings, walls, columns in interstitial spaces.
14. Ceilings, walls, and columns in pipe basements.
15. Wood Shingles.

3.14 IDENTITY PAINTING SCHEDULE:

- A. Identify designated service in new buildings or projects with extensive remodeling in accordance with ASME A13.1, unless specified otherwise, on exposed piping, piping above removable ceilings, piping in accessible pipe spaces, interstitial spaces, and piping behind access panels. For existing spaces where work is minor match existing.
 1. Legend may be identified using snap-on coil plastic markers or by paint stencil applications.
 2. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12.2 M (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.
 3. Locate Legends clearly visible from operating position.
 4. Use arrow to indicate direction of flow using black stencil paint.
 5. Identify pipe contents with sufficient additional details such as temperature, pressure, and contents to identify possible hazard. Insert working pressure shown on construction documents where asterisk appears for High, Medium, and Low Pressure designations as follows:
 - a. High Pressure - 414 kPa (60 psig) and above.
 - b. Medium Pressure - 104 to 413 kPa (15 to 59 psig).
 - c. Low Pressure - 103 kPa (14 psig) and below.
 - d. Add Fuel oil grade numbers.
 6. Legend name in full or in abbreviated form as follows:

PIPING	COLOR OF EXPOSED PIPING	COLOR OF BACKGROUND	COLOR OF LETTERS	LEGEND ABBREVIATIONS
Blow-off		Green	White	Blow-off
Boiler Feedwater		Green	White	Blr Feed
A/C Condenser Water Supply		Green	White	A/C Cond Wtr Sup
A/C Condenser Water Return		Green	White	A/C Cond Wtr Ret
Chilled Water Supply		Green	White	Ch. Wtr Sup

Chilled Water Return		Green	White	Ch. Wtr Ret
Shop Compressed Air		Blue	White	Shop Air
Air-Instrument Controls		Green	White	Air-Inst Cont
Drain Line		Green	White	Drain
Emergency Shower		Green	White	Emg Shower
High Pressure Steam		Green	White	H.P. _____*
High Pressure Condensate Return		Green	White	H.P. Ret _____*
Medium Pressure Steam		Green	White	M. P. Stm _____*
Medium Pressure Condensate Return		Green	White	M.P. Ret _____*
Low Pressure Steam		Green	White	L.P. Stm _____*
Low Pressure Condensate Return		Green	White	L.P. Ret _____*
High Temperature Water Supply		Green	White	H. Temp Wtr Sup
High Temperature Water Return		Green	White	H. Temp Wtr Ret
Hot Water Heating Supply		Green	White	H. W. Htg Sup
Hot Water Heating Return		Green	White	H. W. Htg Ret
Gravity Condensate Return		Green	White	Gravity Cond Ret
Pumped Condensate Return		Green	White	Pumped Cond Ret
Vacuum Condensate Return		Green	White	Vac Cond Ret
(Diesel Fuel included under Fuel Oil)				
Boiler Water Sampling		Green	White	Sample
Chemical Feed		Green	White	Chem Feed
Continuous Blow-Down		Green	White	Cont. B D
Pumped Condensate		Green	White	Pump Cond
Pump Recirculating		Green	White	Pump-Recirc.
Vent Line		Green	White	Vent
Alkali		Orange	Black	Alk
Bleach		Orange	Black	Bleach
Detergent		Yellow	Black	Det
Liquid Supply		Yellow	Black	Liq Sup
Reuse Water		Yellow	Black	Reuse Wtr
Cold Water (Domestic)	White	Green	White	C.W. Dom
Hot Water (Domestic)				
Supply	White	Yellow	Black	H.W. Dom
Return	White	Yellow	Black	H.W. Dom Ret
Tempered Water	White	Yellow	Black	Temp. Wtr
Ice Water				
Supply	White	Green	White	Ice Wtr
Return	White	Green	White	Ice Wtr Ret
Reagent Grade Water		Green	White	RG
Reverse Osmosis		Green	White	RO
Sanitary Waste		Green	White	San Waste
Sanitary Vent		Green	White	San Vent
Storm Drainage		Green	White	St Drain
Pump Drainage		Green	White	Pump Disch

Chemical Resistant Pipe

Waste	Orange	Black	Acid Waste
Vent	Orange	Black	Acid Vent
Atmospheric Vent	Green	White	ATV
Silver Recovery	Green	White	Silver Rec
Oral Evacuation	Green	White	Oral Evac
Fuel Gas	Yellow	Black	Gas
Fire Protection Water			
Sprinkler	Red	White	Auto Spr
Standpipe	Red	White	Stand
Sprinkler	Red	White	Drain

B. Fire and Smoke Partitions:

1. Identify partitions above ceilings on both sides of partitions except within shafts in letters not less than 64 mm (2 1/2 inches) high.
2. Stenciled message: "SMOKE BARRIER" or, "FIRE BARRIER" as applicable.
3. Locate not more than 6096 mm (20 feet) on center on corridor sides of partitions, and with a least one (1) message per room on room side of partition.
4. Use semi-gloss paint of color that contrasts with color of substrate.

C. Identify columns in pipe basements and interstitial space:

1. Apply stenciled number and letters to correspond with grid numbering and lettering indicated on construction documents.
2. Paint numbers and letters 101 mm (4 inches) high, locate 45 mm (18 inches) below overhead structural slab.
3. Apply on four (4) sides of interior columns and on inside face only of exterior wall columns.
4. Color:
 - a. Use black on concrete columns.
 - b. Use white or contrasting color on steel columns.

3.15 PROTECTION CLEAN UP, AND TOUCH-UP:

- A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
- B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.
- C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

- - - E N D - - -

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide (a) direct-digital control system(s) as indicated on the project documents, point list, interoperability tables, drawings and as described in these specifications. Include a complete and working direct-digital control system. Include all engineering, programming, controls and installation materials, installation labor, commissioning and start-up, training, final project documentation and warranty.

Engineering Control Center (ECC) is currently located in the HVAC shop and is monitored by a workstation in the Boiler Plant. The system is a Johnson Controls Metasys Extended Architecture ADX Server that resides on a separate VLAN provided by the VA. All new systems shall tie directly on to this system and be monitored by the Metasys system.

1. The direct-digital control system(s) shall consist of high-speed, peer-to-peer network of DDC controllers, a control system server, and an Engineering Control Center. Provide a remote user using a standard web browser to access the control system graphics and change adjustable setpoints with the proper password.
2. The direct-digital control system(s) shall be native BACnet. All new workstations, controllers, devices and components shall be listed by BACnet Testing Laboratories. All new workstations, controller, devices and components shall be accessible using a Web browser interface and shall communicate exclusively using the ASHRAE Standard 135 BACnet communications protocol without the use of gateways, unless otherwise allowed by this Section of the technical specifications, specifically shown on the design drawings and specifically requested otherwise by the VA.
 - a. If used, gateways shall support the ASHRAE Standard 135 BACnet communications protocol.
 - b. If used, gateways shall provide all object properties and read/write services shown on VA-approved interoperability schedules.
3. The work administered by this Section of the technical specifications shall include all labor, materials, special tools,

equipment, enclosures, power supplies, software, software licenses, Project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, Warranty, specified services and items required for complete and fully functional Controls Systems.

4. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. The contractor administered by this Section of the technical specifications shall provide controllers for each mechanical system. In the event of a network communication failure, or the loss of any other controller, the control system shall continue to operate independently. Failure of the ECC shall have no effect on the field controllers, including those involved with global strategies.

- B. Some products are furnished but not installed by the contractor administered by this Section of the technical specifications. The contractor administered by this Section of the technical specifications shall formally coordinate in writing and receive from other contractors formal acknowledgements in writing prior to submission the installation of the products.

C. Responsibility Table:

Work/Item/System	Furnish	Install	Low Voltage Wiring	Line Power
Control system low voltage and communication wiring	23 09 23	23 09 23	23 09 23	N/A
Terminal units	23	23	N/A	26
Controllers for terminal units	23 09 23	23	23 09 23	16
LAN conduits and raceway	23 09 23	23 09 23	N/A	N/A
Transfer switch monitor	26	23 09 23	23 09 23	26
Sewage Ejector High Level Alarm	33	23 09 23	23 09 23	26

- D. This facility's existing direct-digital control system is manufactured by Johnson Controls Inc. The contractor administered by this Section of the technical specifications shall observe the capabilities,

communication network, services, spare capacity of the existing control system and its ECC prior to beginning work.

1. In all areas of work, remove existing direct-digital control system, communications network and controllers. Replace with new BACnet network and field equipment controllers (FEC's) compliant with this Section of the technical specifications.

- a. The combined system shall operate and function as one complete system including one database of control point objects and global control logic capabilities. Facility operators shall have complete operations and control capability over all systems, new and existing including; monitoring, trending, graphing, scheduling, alarm management, global point sharing, global strategy deployment, graphical operations interface and custom reporting as specified.

- E. This campus has standardized on an existing standard ASHRAE Standard 135, BACnet/IP Control System supported by a preselected controls service company. This entity is referred to as the "Control System Integrator" in this Section of the technical specifications. The Control system integrator is responsible for ECC system graphics and expansion. It also prescribes control system-specific commissioning/verification procedures to the contractor administered by this Section of the technical specification. It lastly provides limited assistance to the contractor administered by this Section of the technical specification in its commissioning/verification work.

1. The General Contractor of this project shall directly hire the Control System Integrator in a contract separate from the contract procuring the controls contractor administered by this Section of the technical specifications.

2. The contractor administered by this Section of the technical specifications shall coordinate all work with the Control System Integrator. The contractor administered by this Section of the technical specifications shall integrate the ASHRAE Standard 135, BACnet/IP control network(s) with the Control System Integrator's area control through an Ethernet connection provided by the Control System Integrator.

3. The contractor administered by this Section of the technical specifications shall provide a peer-to-peer networked, stand-alone, distributed control system. This direct digital control (DDC) system

shall include microprocessor-based controllers, instrumentation, end control devices, wiring, piping, software, and related systems. This contractor is responsible for all device mounting and wiring.

4. Responsibility Table:

Item/Task	Section 23 09 23 contactor	Control system integrator	VA
ECC expansion		X	
ECC programming		X	
Devices, controllers, control panels and equipment	X		
Point addressing: all hardware and software points including setpoint, calculated point, data point(analog/binary), and reset schedule point	X		
Point mapping		X	
Network Programming	X		
ECC Graphics		X	
Controller programming and sequences	X		
Integrity of LAN communications	X		
Electrical wiring	X		
Operator system training		X	
LAN connections to devices	X		
LAN connections to ECC		X	
IP addresses			X
Overall system verification		X	
Controller and LAN system verification	X		

1.2 RELATED WORK

- A. Section 26 05 11, Requirements for Electrical Installations.
- B. Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables (600 Volts and Below).
- C. Section 26 05 26, Grounding and Bonding for Electrical Systems.
- D. Section 26 05 33, Raceway and Boxes for Electrical Systems.

1.2 DEFINITION

- A. Algorithm: A logical procedure for solving a recurrent mathematical problem; A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.
- B. ARCNET: ANSI/ATA 878.1 - Attached Resource Computer Network. ARCNET is a deterministic LAN technology; meaning it's possible to determine the maximum delay before a device is able to transmit a message.
- C. Analog: A continuously varying signal value (e.g., temperature, current, velocity etc).
- D. BACnet: A Data Communication Protocol for Building Automation and Control Networks , ANSI/ASHRAE Standard 135. This communications

protocol allows diverse building automation devices to communicate data over and services over a network.

- E. BACnet/IP: Annex J of Standard 135. It defines and allows for using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP sub-networks that share the same BACnet network number.
- F. BACnet Internetwork: Two or more BACnet networks connected with routers. The two networks may use different LAN technologies.
- G. BACnet Network: One or more BACnet segments that have the same network address and are interconnected by bridges at the physical and data link layers.
- H. BACnet Segment: One or more physical segments of BACnet devices on a BACnet network, connected at the physical layer by repeaters.
- I. BACnet Broadcast Management Device (BBMD): A communications device which broadcasts BACnet messages to all BACnet/IP devices and other BBMDs connected to the same BACnet/IP network.
- J. BACnet Interoperability Building Blocks (BIBBs): BACnet Interoperability Building Blocks (BIBBs) are collections of one or more BACnet services. These are prescribed in terms of an "A" and a "B" device. Both of these devices are nodes on a BACnet internetwork.
- K. BACnet Testing Laboratories (BTL). The organization responsible for testing products for compliance with the BACnet standard, operated under the direction of BACnet International.
- L. Baud: It is a signal change in a communication link. One signal change can represent one or more bits of information depending on type of transmission scheme. Simple peripheral communication is normally one bit per Baud. (e.g., Baud rate = 78,000 Baud/sec is 78,000 bits/sec, if one signal change = 1 bit).
- M. Binary: A two-state system where a high signal level represents an "ON" condition and an "OFF" condition is represented by a low signal level.
- N. BMP or bmp: Suffix, computerized image file, used after the period in a DOS-based computer file to show that the file is an image stored as a series of pixels.
- O. Bus Topology: A network topology that physically interconnects workstations and network devices in parallel on a network segment.
- P. Control Unit (CU): Generic term for any controlling unit, stand-alone, microprocessor based, digital controller residing on secondary LAN or Primary LAN, used for local controls or global controls

- Q. Deadband: A temperature range over which no heating or cooling is supplied, i.e., 22-25 degrees C (72-78 degrees F), as opposed to a single point change over or overlap).
- R. Device: a control system component that contains a BACnet Device Object and uses BACnet to communicate with other devices.
- S. Device Object: Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object requires a unique Object Identifier number on the BACnet internetwork. This number is often referred to as the device instance.
- T. Device Profile: A specific group of services describing BACnet capabilities of a device, as defined in ASHRAE Standard 135-2008, Annex L. Standard device profiles include BACnet Operator Workstations (B-OWS), BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS). Each device used in new construction is required to have a PICS statement listing which service and BIBBs are supported by the device.
- U. Diagnostic Program: A software test program, which is used to detect and report system or peripheral malfunctions and failures. Generally, this system is performed at the initial startup of the system.
- V. Direct Digital Control (DDC): Microprocessor based control including Analog/Digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices in order to achieve a set of predefined conditions.
- W. Distributed Control System: A system in which the processing of system data is decentralized and control decisions can and are made at the subsystem level. System operational programs and information are provided to the remote subsystems and status is reported back to the Engineering Control Center. Upon the loss of communication with the Engineering Control center, the subsystems shall be capable of operating in a stand-alone mode using the last best available data.
- X. Download: The electronic transfer of programs and data files from a central computer or operation workstation with secondary memory devices to remote computers in a network (distributed) system.

- Y. DXF: An AutoCAD 2-D graphics file format. Many CAD systems import and export the DXF format for graphics interchange.
- Z. Electrical Control: A control circuit that operates on line or low voltage and uses a mechanical means, such as a temperature sensitive bimetal or bellows, to perform control functions, such as actuating a switch or positioning a potentiometer.
- AA. Electronic Control: A control circuit that operates on low voltage and uses a solid-state components to amplify input signals and perform control functions, such as operating a relay or providing an output signal to position an actuator.
- BB. Engineering Control Center (ECC): The centralized control point for the intelligent control network. The ECC comprises of personal computer and connected devices to form a single workstation.
- CC. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.
- DD. Firmware: Firmware is software programmed into read only memory (ROM) chips. Software may not be changed without physically altering the chip.
- EE. Gateway: Communication hardware connecting two or more different protocols. It translates one protocol into equivalent concepts for the other protocol. In BACnet applications, a gateway has BACnet on one side and non-BACnet (usually proprietary) protocols on the other side.
- FF. GIF: Abbreviation of Graphic interchange format.
- GG. Graphic Program (GP): Program used to produce images of air handler systems, fans, chillers, pumps, and building spaces. These images can be animated and/or color-coded to indicate operation of the equipment.
- HH. Graphic Sequence of Operation: It is a graphical representation of the sequence of operation, showing all inputs and output logical blocks.
- II. I/O Unit: The section of a digital control system through which information is received and transmitted. I/O refers to analog input (AI, digital input (DI), analog output (AO) and digital output (DO). Analog signals are continuous and represent temperature, pressure, flow rate etc, whereas digital signals convert electronic signals to digital pulses (values), represent motor status, filter status, on-off equipment etc.
- JJ. I/P: a method for conveying and routing packets of information over LAN paths. User Datagram Protocol (UDP) conveys information to "sockets"

without confirmation of receipt. Transmission Control Protocol (TCP) establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

- KK. JPEG: A standardized image compression mechanism stands for Joint Photographic Experts Group, the original name of the committee that wrote the standard.
- LL. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.
- MM. Network Repeater: A device that receives data packet from one network and rebroadcasts to another network. No routing information is added to the protocol.
- NN. MS/TP: Master-slave/token-passing (ISO/IEC 8802, Part 3). It is not an acceptable LAN option for VA facilities. It uses twisted-pair wiring for relatively low speed and low cost communication.
- OO. Native BACnet Device: A device that uses BACnet as its primary method of communication with other BACnet devices without intermediary gateways. A system that uses native BACnet devices at all levels is a native BACnet system.
- PP. Network Number: A site-specific number assigned to each network segment to identify for routing. This network number must be unique throughout the BACnet internetwork.
- QQ. Object: The concept of organizing BACnet information into standard components with various associated properties. Examples include analog input objects and binary output objects.
- RR. Object Identifier: An object property used to identify the object, including object type and instance. Object Identifiers must be unique within a device.
- SS. Object Properties: Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.
- TT. Operating system (OS): Software, which controls the execution of computer application programs.
- UU. PCX: File type for an image file. When photographs are scanned onto a personal computer they can be saved as PCX files and viewed or changed by a special application program as Photo Shop.

- VV. Peripheral: Different components that make the control system function as one unit. Peripherals include monitor, printer, and I/O unit.
- WW. Peer-to-Peer: A networking architecture that treats all network stations as equal partners- any device can initiate and respond to communication with other devices.
- XX. PICS: Protocol Implementation Conformance Statement, describing the BACnet capabilities of a device. All BACnet devices have published PICS.
- YY. PID: Proportional, integral, and derivative control, used to control modulating equipment to maintain a setpoint.
- ZZ. Repeater: A network component that connects two or more physical segments at the physical layer.
- AAA. Router: a component that joins together two or more networks using different LAN technologies. Examples include joining a BACnet Ethernet LAN to a BACnet MS/TP LAN.
- BBB. Sensors: devices measuring state points or flows, which are then transmitted back to the DDC system.
- CCC. Thermostats : devices measuring temperatures, which are used in control of standalone or unitary systems and equipment not attached to the DDC system.

1.4 QUALITY ASSURANCE

A. Criteria:

1. Single Source Responsibility of subcontractor: The Contractor shall obtain hardware and software supplied under this Section and delegate the responsibility to a single source controls installation subcontractor. The controls subcontractor shall be responsible for the complete design, installation, and commissioning of the system. The controls subcontractor shall be in the business of design, installation and service of such building automation control systems similar in size and complexity.
2. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.
3. The controls subcontractor shall provide a list of no less than five similar projects which have building control systems as specified in this Section. These projects must be on-line and functional such

that the Department of Veterans Affairs (VA) representative would observe the control systems in full operation.

4. The controls subcontractor shall have in-place facility within 50 miles with technical staff, spare parts inventory for the next five (5) years, and necessary test and diagnostic equipment to support the control systems.
5. The controls subcontractor shall have minimum of three years experience in design and installation of building automation systems similar in performance to those specified in this Section. Provide evidence of experience by submitting resumes of the project manager, the local branch manager, project engineer, the application engineering staff, and the electronic technicians who would be involved with the supervision, the engineering, and the installation of the control systems. Training and experience of these personnel shall not be less than three years. Failure to disclose this information will be a ground for disqualification of the supplier.
6. Provide a competent and experienced Project Manager employed by the Controls Contractor. The Project Manager shall be supported as necessary by other Contractor employees in order to provide professional engineering, technical and management service for the work. The Project Manager shall attend scheduled Project Meetings as required and shall be empowered to make technical, scheduling and related decisions on behalf of the Controls Contractor.
7. The Controls and Instrumentation System Contractor shall be a Johnson Controls primary equipment manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Facility Management System of similar size, scope and complexity to the EEC specified in this Contract. Distributors, manufacturer's representatives and wholesalers will not be acceptable.

B. Codes and Standards:

1. All work shall conform to the applicable Codes and Standards.
2. Electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.

1.5 PERFORMANCE

- A. The system shall conform to the following:

1. Graphic Display: The system shall display up to four (4) graphics on a single screen with a minimum of twenty (20) dynamic points per graphic. All current data shall be displayed within ten (10) seconds of the request.
2. Graphic Refresh: The system shall update all dynamic points with current data within eight (8) seconds. Data refresh shall be automatic, without operator intervention.
3. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be two(2) seconds. Analog objects shall start to adjust within two (2) seconds.
4. Object Scan: All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or work-station will be current, within the prior six (6) seconds.
5. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed (10) seconds.
6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every (5) seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Multiple Alarm Annunciations: All workstations on the network shall receive alarms within five (5) seconds of each other.
8. Performance: Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every one (1) second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
9. Extent of direct digital control: control design shall allow for at least the points indicated on the points lists on the drawings.

1.6 WARRANTY

- A. Labor and materials for control systems shall be warranted for a period as specified under Warranty in FAR clause 52.246-21.
- B. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no cost or reduction in service to the owner. The system includes all computer equipment, transmission equipment, and all sensors and control devices.

C. Controls and Instrumentation subcontractor shall be responsible for temporary operations and maintenance of the control systems during the construction period until final commissioning, training of facility operators and acceptance of the project by VA.

1.7 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's literature and data for all components including the following:
 - 1. A wiring diagram for each type of input device and output device including DDC controllers, modems, repeaters, etc. Diagram shall show how the device is wired and powered, showing typical connections at the digital controllers and each power supply, as well as the device itself. Show for all field connected devices, including but not limited to, control relays, motor starters, electric or electronic actuators, and temperature pressure, flow and humidity sensors and transmitters.
 - 2. A diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and the associated point names.
 - 3. Control dampers and control valves schedule, including the size and pressure drop.
 - 4. Control air-supply components, and computations for sizing compressors, receivers and main air-piping, if pneumatic controls are furnished.
 - 5. Catalog cut sheets of all equipment used. This includes, but is not limited to software (by manufacturer and by third parties), DDC controllers, panels, peripherals, airflow measuring stations and associated components, and auxiliary control devices such as sensors, actuators, and control dampers. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted. Each submitted piece of literature and drawings should clearly reference the specification and/or drawings that it supposed to represent.

6. Sequence of operations for each HVAC system and the associated control diagrams. Equipment and control labels shall correspond to those shown on the drawings.
 7. Color prints of proposed graphics with a list of points for display.
 8. Furnish a BACnet Protocol Implementation Conformance Statement (PICS) for each BACnet-compliant device.
 9. Schematic wiring diagrams for all control, communication and power wiring.
 10. An instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model number, and product data sheet number.
 11. Riser diagrams of wiring between central control unit and all control panels.
 12. Quantities of submitted items may be reviewed but are the responsibility of the contractor administered by this Section of the technical specifications.
- C. Product Certificates: Compliance with Article, QUALITY ASSURANCE.
- D. Licenses: Provide licenses for all software residing on and used by the Controls Systems and transfer these licenses to the Owner prior to completion.
- E. As Built Control Drawings:
1. Furnish three (3) copies of as-built drawings for each control system. The documents shall be submitted for approval prior to final completion.
 2. Furnish one (1) stick set of applicable control system prints for each mechanical system for wall mounting. The documents shall be submitted for approval prior to final completion.
 3. Furnish one (1) CD-ROM in CAD DWG or .DXF or Adobe PDF format for the drawings noted in subparagraphs above.
- F. Operation and Maintenance (O/M) Manuals):
1. Submit in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS.
 2. Include the following documentation:
 - a. General description and specifications for all components, including logging on/off, alarm handling, producing trend reports, overriding computer control, and changing set points and other variables.

- b. Detailed illustrations of all the control systems specified for ease of maintenance and repair/replacement procedures, and complete calibration procedures.
 - c. One copy of the final version of all software provided including operating systems, programming language, operator workstation software, and graphics software.
 - d. Complete troubleshooting procedures and guidelines for all systems.
 - e. Complete operating instructions for all systems.
 - f. Recommended preventive maintenance procedures for all system components including a schedule of tasks for inspection, cleaning and calibration. Provide a list of recommended spare parts needed to minimize downtime.
 - g. Training Manuals: Submit the course outline and training material to the Owner for approval three (3) weeks prior to the training to VA facility personnel. These persons will be responsible for maintaining and the operation of the control systems, including programming. The Owner reserves the right to modify any or all of the course outline and training material.
 - h. Licenses, guaranty, and other pertaining documents for all equipment and systems.
- G. Submit Performance Report to COR prior to final inspection.

1.8 INSTRUCTIONS

- A. Instructions to VA operations personnel: Perform in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS, and as noted below.
- B. Schedule training sessions with COR and Contractor. If less than two VA staff are available, reschedule training at no cost to VA.
 - 1. First Phase: Formal instructions to the VA facilities personnel for a total of 4 hours, given in multiple training sessions (each no longer than four hours in length), conducted sometime between the completed installation and prior to the performance test period of the control system, at a time mutually agreeable to the Contractor and the VA.
 - 2. The O/M Manuals shall contain approved submittals as outlined in Article 1.7, SUBMITTALS. The Controls subcontractor will review the manual contents with VA facilities personnel during second phase of

training. O/M Manuals shall be provided 15 days before formal training.

3. Training shall be given by direct employees of the controls system subcontractor.

1.9 PROJECT CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)

- A. The ECC and peripheral devices and system support equipment shall be designed to operate in ambient condition of 20 to 35°C (65 to 90°F) at a relative humidity of 20 to 80% non-condensing.
- B. The CUs used outdoors shall be mounted in NEMA 4 waterproof enclosures, and shall be rated for operation at -40 to 65°C (-40 to 150°F).
- C. All electronic equipment shall operate properly with power fluctuations of plus 10 percent to minus 15 percent of nominal supply voltage.
- D. Sensors and controlling devices shall be designed to operate in the environment, which they are sensing or controlling.

1.10 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
Standard 135-10.....BACNET Building Automation and Control Networks
- C. American Society of Mechanical Engineers (ASME):
B16.18-01.....Cast Copper Alloy Solder Joint Pressure Fittings.
B16.22-01.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. American Society of Testing Materials (ASTM):
B32-08.....Standard Specification for Solder Metal
B88-09.....Standard Specifications for Seamless Copper Water Tube
B88M-09.....Standard Specification for Seamless Copper Water Tube (Metric)
B280-08.....Standard Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service
D2737-03.....Standard Specification for Polyethylene (PE) Plastic Tubing
- E. Federal Communication Commission (FCC):
Rules and Regulations Title 47 Chapter 1-2001 Part 15: Radio Frequency Devices.
- F. Institute of Electrical and Electronic Engineers (IEEE):

802.3-11.....Information Technology-Telecommunications and
 Information Exchange between Systems-Local and
 Metropolitan Area Networks- Specific
 Requirements-Part 3: Carrier Sense Multiple
 Access with Collision Detection (CSMA/CD)
 Access method and Physical Layer Specifications

G. National Fire Protection Association (NFPA):

70-11.....National Electric Code
 90A-09.....Standard for Installation of Air-Conditioning
 and Ventilation Systems

H. Underwriter Laboratories Inc (UL):

94-10.....Tests for Flammability of Plastic Materials for
 Parts and Devices and Appliances
 294-10.....Access Control System Units
 486A/486B-10.....Wire Connectors
 555S-11.....Standard for Smoke Dampers
 916-10.....Energy Management Equipment
 1076-10.....Proprietary Burglar Alarm Units and Systems

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use new products that the manufacturer is currently manufacturing and that have been installed in a minimum of 25 installations. Spare parts shall be available for at least five years after completion of this contract.

2.2 CONTROLS SYSTEM ARCHITECTURE

A. General

1. The Controls Systems shall consist of multiple Nodes and associated equipment connected by industry standard digital and communication network arrangements.
2. The ECC, building controllers and principal communications network equipment shall be standard products of recognized major manufacturers available through normal PC and computer vendor channels - not "Clones" assembled by a third-party subcontractor.
3. The networks shall, at minimum, comprise, as necessary, the following:
 - a. A fixed ECC and a portable operator's terminal.
 - b. Network computer processing, data storage and BACnet-compliant communication equipment including Servers and digital data processors.
 - c. BACnet-compliant routers, bridges, switches, hubs, modems, gateways, interfaces and similar communication equipment.

- d. Active processing BACnet-compliant building controllers connected to other BACNet-compliant controllers together with their power supplies and associated equipment.
 - e. Addressable elements, sensors, transducers and end devices.
 - f. Third-party equipment interfaces and gateways as described and required by the Contract Documents.
 - g. Other components required for a complete and working Control Systems as specified.
- B. The Specifications for the individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the Contractor to achieve both compliance with all applicable codes, standards and to meet all requirements of the Contract Documents.
- C. Network Architecture
 - 1. The Controls communication network shall utilize BACnet communications protocol operating over a standard Ethernet LAN and operate at a minimum speed of 100 Mb/sec.
 - 2. The networks shall utilize only copper and optical fiber communication media as appropriate and shall comply with applicable codes, ordinances and regulations.
 - 3. All necessary telephone lines, ISDN lines and internet Service Provider services and connections will be provided by the VA.
- D. Third Party Interfaces:
 - 1. The contractor administered by this Section of the technical specifications shall include necessary hardware, equipment, software and programming to allow data communications between the controls systems and building systems supplied by other trades.
 - 2. Other manufacturers and contractors supplying other associated systems and equipment shall provide their necessary hardware, software and start-up at their cost and shall cooperate fully with the contractor administered by this Section of the technical specifications in a timely manner and at their cost to ensure complete functional integration.
- E. Servers:
 - 1. The existing server in the ECC will be used as the server to archive historical data including trends, alarm and event histories and transaction logs.
 - 2. Access to all information on the data storage server(s) shall be through the same browser functionality used to access individual

nodes. When logged onto a server the operator will be able to also interact with any other controller on the control system as required for the functional operation of the controls systems. The contractor administered by this Section of the technical specifications shall provide all necessary digital processor programmable data storage server(s).

3. These server(s) shall be utilized for controls systems application configuration, for archiving, reporting and trending of data, for operator transaction archiving and reporting, for network information management, for alarm annunciation, for operator interface tasks, for controls application management and similar. These server(s) shall utilize IT industry standard data base platforms which utilize a database declarative language designed for managing data in relational database management systems (RDBMS) such as SQL.

2.3 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135-2008, BACnet.
 1. The Data link / physical layer protocol (for communication) acceptable to the VA throughout its facilities is Ethernet (ISO 8802-3) and BACnet/IP.
 2. The MS/TP data link / physical layer protocol is not acceptable to the VA in any new BACnet network or sub-network in its healthcare or lab facilities.
- B. Each controller shall have a communication port for connection to an operator interface.
- C. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, reports, system software, and custom programs shall be viewable and editable from each internetwork controller.
 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-

controller links required to execute specified control system operation. An authorized operator shall be able to edit cross-controller links by typing a standard object address.

- D. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring. Expansion shall not require operator interface hardware additions or software revisions.
- E. ECCs and Controllers with real-time clocks shall use the BACnet Time Synchronization service. The system shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight savings and standard time as applicable.

2.4 NETWORK AND DEVICE NAMING CONVENTION

- A. Controls Contractor shall use naming conventions consistent with those currently in place at the facility.

2.5 BACNET DEVICES

- A. All BACnet Devices - controllers, gateways, routers, actuators and sensors shall conform to BACnet Device Profiles and shall be BACnet Testing Laboratories (BTL) -Listed as conforming to those Device Profiles. Protocol Implementation Conformance Statements (PICSs), describing the BACnet capabilities of the Devices shall be published and available of the Devices through links in the BTL website.
 - 1. BACnet Building Controllers, historically referred to as NACs, shall conform to the BACnet B-BC Device Profile, and shall be BTL-Listed as conforming to the B-BC Device Profile. The Device's PICS shall be submitted.
 - 2. BACnet Advanced Application Controllers shall conform to the BACnet B-AAC Device Profile, and shall be BTL-Listed as conforming to the B-AAC Device Profile. The Device's PICS shall be submitted.
 - 3. BACnet Application Specific Controllers shall conform to the BACnet B-ASC Device Profile, and shall be BTL-Listed as conforming to the B-ASC Device Profile. The Device's PICS shall be submitted.
 - 4. BACnet Smart Actuators shall conform to the BACnet B-SA Device Profile, and shall be BTL-Listed as conforming to the B-SA Device Profile. The Device's PICS shall be submitted.

5. BACnet Smart Sensors shall conform to the BACnet B-SS Device Profile, and shall be BTL-Listed as conforming to the B-SS Device Profile. The Device's PICS shall be submitted.
6. BACnet routers and gateways shall conform to the BACnet B-OTH Device Profile, and shall be BTL-Listed as conforming to the B-OTH Device Profile. The Device's PICS shall be submitted.

2.6 CONTROLLERS

- A. General. Provide an adequate number of BTL-Listed B-BC building controllers and an adequate number of BTL-Listed B-AAC advanced application controllers to achieve the performance specified in the Part 1 Article on "System Performance." Each of these controllers shall meet the following requirements.
 1. The controller shall have sufficient memory to support its operating system, database, and programming requirements.
 2. The building controller shall share data with the ECC and the other networked building controllers. The advanced application controller shall share data with its building controller and the other networked advanced application controllers.
 3. The operating system of the controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
 4. Controllers that perform scheduling shall have a real-time clock.
 5. The controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. assume a predetermined failure mode, and
 - b. generate an alarmnotification.
 6. The controller shall communicate with other BACnet devices on the internetwork using the BACnet Read (Execute and Initiate) and Write (Execute and Initiate) Property services.
 7. Communication.
 - a. Each controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications. Each building controller also shall perform BACnet routing if connected to a network of custom application and application specific controllers.

- b. The controller shall provide a service communication port using BACnet Data Link/Physical layer protocol for connection to a portable operator's terminal.
- 8. Keypad. A local keypad and display shall be provided for each controller. The keypad shall be provided for interrogating and editing data. Provide a system security password shall be available to prevent unauthorized use of the keypad and display.
- 9. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
- 10. Memory. The controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- 11. The controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Controller operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- B. Provide BTL-Listed B-ASC application specific controllers for each piece of equipment for which they are constructed. Application specific controllers shall communicate with other BACnet devices on the internetwork using the BACnet Read (Execute) Property service.
 - 1. Each B-ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 - 2. Each B-ASC will contain sufficient I/O capacity to control the target system.
 - 3. Communication.
 - a. Each network controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications. Each building controller also shall perform BACnet routing if connected to a network of custom application and application specific controllers.
 - b. Each controller shall have a BACnet Data Link/Physical layer compatible connection for a laptop computer or a portable operator's tool. This connection shall be extended to a space temperature sensor port where shown.

4. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
5. Memory. The application specific controller shall use nonvolatile memory and maintain all BIOS and programming information in the event of a power loss.
6. Immunity to power and noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
7. Transformer. Power supply for the ASC must be rated at a minimum of 125% of ASC power consumption and shall be of the fused or current limiting type.

C. Direct Digital Controller Software

1. The software programs specified in this section shall be commercially available, concurrent, multi-tasking operating system and support the use of software application that operates under DOS or Microsoft Windows.
2. All points shall be identified by up to 30-character point name and 16-character point descriptor. The same names shall be used at the ECC.
3. All control functions shall execute within the stand-alone control units via DDC algorithms. The VA shall be able to customize control strategies and sequences of operations defining the appropriate control loop algorithms and choosing the optimum loop parameters.
4. System Security: Operator access shall be secured using individual password and operator's name. Passwords shall restrict the operator to the level of object, applications, and system functions assigned to him. A minimum of six (6) levels of security for operator access shall be provided.
5. Application Software: The controllers shall provide the following programs as a minimum for the purpose of optimizing energy consumption while maintaining comfortable environment for occupants. All application software shall reside and run in the system digital controllers. Editing of the application shall occur at the ECC or

via a portable operator's terminal, when it is necessary, to access directly the programmable unit.

- a. Alarm Reporting: The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the ECC based on time and events. An alarm shall be able to start programs, login the event, print and display the messages. The system shall allow the operator to prioritize the alarms to minimize nuisance reporting and to speed operator's response to critical alarms. A minimum of six (6) priority levels of alarms shall be provided for each point.
- b. Remote Communications: The system shall have the ability to dial out in the event of an alarm to the ECC and alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications. Remote access shall allow the operator to function the same as local access.

2.7 CONTROL CABLES

A. General:

1. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Comply with Sections 26 05 19 and 26 05 26.
2. Cable conductors to provide protection against induction in circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.
3. Minimize the radiation of RF noise generated by the System equipment so as not to interfere with any audio, video, data, computer main distribution frame (MDF), telephone customer service unit (CSU), and electronic private branch exchange (EPBX) equipment the System may service.
4. The as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs.
5. Label system's cables on each end. Each cable to be labeled with a labeling machine. Test and certify cables in writing to the VA before conducting proof-of-performance testing. Minimum cable test requirements are for impedance compliance, inductance, capacitance,

- signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on all cables in the frequency ranges used. Make available all cable installation and test records at demonstration to the VA. All changes (used pair, failed pair, etc.) shall be posted in these records as the change occurs.
6. Power wiring shall not be run in conduit with communications trunk wiring or signal or control wiring operating at 100 volts or less.
- B. Analogue control cabling shall be not less than No. 18 AWG solid, with thermoplastic insulated conductors as specified in Section 26 05 19.
- C. Copper digital communication cable between the ECC and the B-BC and B-AAC controllers shall be 100BASE-TX Ethernet, Category 5e or 6, not less than minimum 24 American Wire Gauge (AWG) solid, Shielded Twisted Pair (STP) or Unshielded Twisted Pair (UTP), with thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, as specified in Section 26 05 19.
1. Other types of media commonly used within IEEE Std 802.3 LANs (e.g., 10Base-T and 10Base-2) shall be used only in cases to interconnect with existing media.
- D. Optical digital communication fiber, if used, shall be Multimode or Singlemode fiber, 62.5/125 micron for multimode or 10/125 micron for singlemode micron with SC or ST connectors as specified in TIA-568-C.1. Terminations, patch panels, and other hardware shall be compatible with the specified fiber and shall be as specified in Section 26 05 19. Fiber-optic cable shall be suitable for use with the 100Base-FX or the 100Base-SX standard (as applicable) as defined in IEEE Std 802.3.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
1. Examine project plans for control devices and equipment locations; and report any discrepancies, conflicts, or omissions to COR for resolution before proceeding for installation.
 2. Install equipment, piping, wiring /conduit parallel to or at right angles to building lines.
 3. Install all equipment and piping in readily accessible locations. Do not run tubing and conduit concealed under insulation or inside ducts.

4. Mount control devices, tubing and conduit located on ducts and apparatus with external insulation on standoff support to avoid interference with insulation.
5. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
6. Run tubing and wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing.
7. Install equipment level and plum.
8. Labeling: All equipment, wires, boxes, and sensors to be labeled with label machine.

B. Electrical Wiring Installation:

1. All wiring cabling shall be installed in conduits. Install conduits and wiring in accordance with Specification Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Conduits carrying control wiring and cabling shall be dedicated to the control wiring and cabling: these conduits shall not carry power wiring. Provide plastic end sleeves at all conduit terminations to protect wiring from burrs.
2. Install analog signal and communication cables in conduit and in accordance with Specification Section 26 05 19. Install digital communication cables in conduit and in accordance with Specification Section 26 05 19, Communications Horizontal Cabling.
3. Install conduit and wiring between operator workstation(s), digital controllers, electrical panels, indicating devices, instrumentation, miscellaneous alarm points, thermostats, and relays as shown on the drawings or as required under this section.
4. Install all electrical work required for a fully functional system and not shown on electrical plans or required by electrical specifications. Where low voltage (less than 50 volt) power is required, provide suitable Class B transformers.
5. Install all system components in accordance with local Building Code and National Electric Code.
 - a. Splices: Splices in shielded and coaxial cables shall consist of terminations and the use of shielded cable couplers. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties.

- b. Equipment: Fit all equipment contained in cabinets or panels with service loops, each loop being at least 300 mm (12 inches) long. Equipment for fiber optics system shall be rack mounted, as applicable, in ventilated, self-supporting, code gauge steel enclosure. Cables shall be supported for minimum sag.
 - c. Cable Runs: Keep cable runs as short as possible. Allow extra length for connecting to the terminal board. Do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter.
 - d. Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.
- 6. Conceal cables, except in mechanical rooms and areas where other conduits and piping are exposed.
- 7. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-coded cable with cable diagrams may be used to accomplish cable identification.
- 8. Grounding: ground electrical systems per manufacturer's written requirements for proper and safe operation.
- 9. DDC Controls power: All DDC controls power shall be connected to emergency UPS power down to local area controls.
- C. Installation of network:
 - 1. Ethernet:
 - a. The network shall employ Ethernet LAN architecture, as defined by IEEE 802.3. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed IEEE 802.3, Compliant Ethernet Networks.
 - b. The network shall directly support connectivity to a variety of cabling types. As a minimum provide the following connectivity: 100 Base TX (Category 5e cabling) for the communications between the ECC and the B-BC and the B-AAC controllers.
 - 2. Third party interfaces: Contractor shall integrate real-time data from building systems by other trades and databases originating from other manufacturers as specified and required to make the system work as one system.
- D. Installation of digital controllers and programming:
 - 1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, chiller, pumping unit etc.

Points used for control loop reset such as outdoor air, outdoor humidity, or space temperature could be located on any of the remote control units.

2. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25 percent of available memory free for future use.
3. System point names shall be modular in design, permitting easy operator interface without the use of a written point index.
4. Provide software programming for the applications intended for the systems specified, and adhere to the strategy algorithms provided.
5. Provide graphics for each point. These graphics shall show all points dynamically as specified in the point list.

3.2 SYSTEM VALIDATION AND DEMONSTRATION

- A. As part of final system acceptance, a system demonstration is required (see below). Prior to start of this demonstration, the contractor is to perform a complete validation of all aspects of the controls and instrumentation system. Prior notice shall be given to COR and VA staff of when final system demonstration will be performed.
- B. Demonstration
 1. System operation and calibration to be demonstrated by the installer in the presence of the Architect or VA's representative on random samples of equipment as dictated by the Architect or VA's representative. Should random sampling indicate improper commissioning, the owner reserves the right to subsequently witness complete calibration of the system at no addition cost to the VA.
 2. Demonstrate to authorities that all required safeties and life safety functions are fully functional and complete.
 3. Make accessible, personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.
 4. The following witnessed demonstrations of field control equipment shall be included:
 - a. Observe HVAC systems in shut down condition. Check dampers and valves for normal position.
 - b. Test application software for its ability to communicate with digital controllers, operator workstation, and uploading and downloading of control programs.
 - c. Demonstrate the software ability to edit the control program off-line.

- d. Demonstrate reporting of alarm conditions for each alarm and ensure that these alarms are received at the assigned location, including operator workstations.
 - e. Demonstrate ability of software program to function for the intended applications-trend reports, change in status etc.
 - f. Demonstrate via graphed trends to show the sequence of operation is executed in correct manner, and that the HVAC systems operate properly through the complete sequence of operation, e.g., seasonal change, occupied/unoccupied mode, and warm-up condition.
 - g. Demonstrate hardware interlocks and safeties functions, and that the control systems perform the correct sequence of operation after power loss and resumption of power loss.
5. Witnessed demonstration of ECC functions shall consist of:
- a. Running each specified report.
 - b. Display and demonstrate each data entry to show site specific customizing capability. Demonstrate parameter changes.
 - c. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
 - d. Execute digital and analog commands in graphic mode.
 - e. Demonstrate DDC loop precision and stability via trend logs of inputs and outputs (6 loops minimum).
 - f. Demonstrate EMS performance via trend logs and command trace.
 - g. Demonstrate scan, update, and alarm responsiveness.
 - h. Demonstrate spreadsheet/curve plot software, and its integration with database.
 - i. Demonstrate on-line user guide, and help function and mail facility.
 - j. Demonstrate digital system configuration graphics with interactive upline and downline load, and demonstrate specified diagnostics.
 - k. Demonstrate multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
 - l. Demonstrate class programming with point options of beep duration, beep rate, alarm archiving, and color banding.

----- 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, automatic transfer switches, conductors and cable, switchboards, switchgear, panelboards, and other items and arrangements for the specified items in the Contract Documents.
- C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the Government's Electrical system shall conform to the Government's requirements. Coordinate fuses, circuit breakers and relays with the Government's system, and obtain Government approval for sizes and settings of these devices.
- D. Conductor ampacities specified or indicated in the Contract Documents are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. The latest International Building Code (IBC), Underwriters Laboratories, Inc. (UL), Institute of Electrical and Electronics Engineers (IEEE), 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 four 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 shall be 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. Materials and equipment furnished shall be new, and shall have superior quality and freshness.
- 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 Tests are specified, Factory Tests shall be performed in the factory by the equipment manufacturer, and witnessed by the

contractor. In addition, the following requirements shall be complied with:

1. The Government shall have the option of witnessing factory tests.
The Contractor shall notify the Government through the COR a minimum of thirty (30) days prior to the manufacturer's performing of the factory tests.
2. When factory tests are successful, contractor shall furnish four (4) copies of the equipment manufacturer's certified test reports to the COR fourteen (14) days prior to shipment of the equipment, and not more than ninety (90) days after completion of the factory tests.
3. When factory tests are not successful, factory tests shall be repeated in the factory by the equipment manufacturer, and witnessed by the Contractor. The Contractor shall be liable for all additional expenses for the Government to witness factory 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 COR.
 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.

5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

- A. All electrical work shall comply with requirements of the latest NFPA 70 (NEC), NFPA 70B, NFPA 70E, NFPA 99, NFPA 110, 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. However, energized electrical work may be performed only for the non-destructive and non-invasive diagnostic testing(s), or when scheduled outage poses an imminent hazard to patient care, safety, or physical security. In such case, all aspects of energized electrical work, such as the availability of appropriate/correct personal protective equipment (PPE) and the use of PPE, shall comply with the latest NFPA 70E, as well as the following requirements:
 1. Only Qualified Person(s) shall perform energized electrical work. Supervisor of Qualified Person(s) shall witness the work of its entirety to ensure compliance with safety requirements and approved work plan.
 2. At least two weeks before initiating any energized electrical work, the Contractor and the Qualified Person(s) who is designated to perform the work shall visually inspect, verify and confirm that the work area and electrical equipment can safely accommodate the work involved.
 3. At least two weeks before initiating any energized electrical work, the Contractor shall develop and submit a job specific work plan, and energized electrical work request to the COR, and Medical Center's Chief Engineer or his/her designee. At the minimum, the work plan must include relevant information such as proposed work schedule, area of work, description of work, name(s) of Supervisor and Qualified Person(s) performing the work, equipment to be used, procedures to be used on and near the live electrical equipment,

- barriers to be installed, safety equipment to be used, and exit pathways.
4. Energized electrical work shall begin only after the Contractor has obtained written approval of the work plan, and the energized electrical work request from the COR, and Medical Center's Chief Engineer or his/her designee. The Contractor shall make these approved documents present and available at the time and place of energized electrical work.
 5. Energized electrical work shall begin only after the Contractor has invited and received acknowledgment from the COR, and Medical Center's Chief Engineer or his/her designee to witness the work.
 - 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 Government's electrical system shall conform to the Government's requirements. Coordinate fuses, circuit

breakers and relays with the Government's electrical system, and obtain Government 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 bolts or rivets.
- C. Install adhesive arc flash warning labels on all equipment as required by the latest NFPA 70E. Label shall show specific and correct information for specific equipment based on its arc flash calculations. Contractor is responsible for providing the calculations to determine the required values. Label shall show the followings:
 - 1. Nominal system voltage.
 - 2. Equipment/bus name, date prepared, and manufacturer name and address.
 - 3. Arc flash boundary.
 - 4. Available arc flash incident energy and the corresponding working distance.
 - 5. Minimum arc rating of clothing.
 - 6. Site-specific level of PPE.

1.12 SUBMITTALS

- A. Submit to the COR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or

installation of materials and equipment which has not had prior approval will not be permitted.

- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION _____".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
- E. Submittals shall be provided per individual specification section. Submittals which combine work of multiple specifications sections will not be reviewed and will be returned at the expense of the Contractor.
- F. 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.
 - 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.
- G. 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.
 - H. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
 - I. After approval and prior to installation, furnish the COR 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 for the equipment. Repair, replacement, and re-testing 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 and factory-trained 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 factory-trained in operating theory as well as practical operation and maintenance procedures.
 - a. If the Government deems the instructor or trainer as not competent, the Government may request a different trainer or instructor at any

time and is not required to give further justification other than stating the trainer has been found to be not competent in the areas of which they are to be providing the service. Contractor must comply with the request in 2-weeks at no additional expense to the Government.

C. A training schedule shall be developed and submitted by the Contractor and approved by the COR at least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

---END---

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. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-resistant rated construction.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.
- E. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Installation of conductors and cables in manholes and ducts.

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 and XHHW-2. XHHW-2 shall be used for isolated power systems.
- D. Color Code:
 - 1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
 - 2. No. 8 AWG and larger: Color-coded using one of the following methods:
 - a. Solid color insulation or solid color coating.
 - b. Stripes, bands, or hash marks of color specified.
 - c. Color using 19 mm (0.75 inches) wide tape.
 - 4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
 - 5. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White*	Neutral	Gray *
*with colored tracer to match phase color when provided with single phase circuits.		

- 6. Lighting circuit "switch legs", and 3-way and 4-way switch "traveling wires," shall have color coding that is unique and distinct from the color coding indicated above. The unique color codes shall be solid and as follows and in accordance with the NEC.
 - a. Switch leg conductors shall be pink in color.
 - b. 4-way switch traveling conductors shall be purple in color.

7. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES

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

2.6 OPTICAL FIBER BACKBONE CABLE

- A. The following manufacturer's products are acceptable for use in the work under this Division section: Mohawk/CDT, Superio-Essex, Hitachi or equal.
- B. The optical fiber cable shall consist of one type of optical fiber:
 - 1. One 6 (6) strand, 8.3/125 micrometer Single-mode cable
- C. All fiber backbone cabling shall meet the minimum industry standards for the intended use, and carry a documented rating for verification and independently verified.
- D. All backbone cabling shall be ONFP rated, with an inter-locking armored sheath. No exceptions shall be made.
- E. Additional minimum cable specifications shall be as follows:
 - 1. Crush Resistance: EIA-FOTP-411500n/cm
 - 2. Impact Resistance: EIA-FOTP-25 at 1.6nm, 1000 cycles
 - 3. Flexing: EIA-FOTP-104
 - 4. Max Pulling Load: EIA-FOTP-33, 1800 newtons
 - 5. Min Bend Radius: twenty (20) times outside diameter of cable during installation. Ten (10) times outside diameter after installation.
 - 6. Max safe operating load: 1000 newtons
 - 7. Factory/Manufacturer recommended installation and storage temperatures.

2.7 COPPER UTP BACKBONE CABLE

- A. The following manufacturer's products are acceptable for use in the work under this Division section: Mohawk/CDT, Superio-Essex, Hitachi or equal.

- B. Backbone cabling shall be a minimum of CAT3, but CAT5 is also acceptable if CAT3 is unavailable. This cabling system shall be used to support the intercom paging functions.
- C. Copper backbone cabling shall have the number of pairs as indicated on the Contract Documents. Conductors shall be solid core, 24 AWG, and RoHS compliant.
- D. Cabling sheath color shall be Grey, and shall be CMP rated for use in plenum spaces. No exceptions so the cable rating shall be accepted.
- E. The cabling shall be capable of no less than ten (10) times cable diameter for bend radius during installation, and no less than eight (8) times cable diameter after installation.
- F. Cable materials shall be certified, and marked to meet or exceed all CAT3/CAT5 mechanical and performance characteristics up to or exceeding the appropriate MHz rating as specified in ANSI/ EIA/ TIA-568 including: color codes, cable diameter, breaking strength, bending radius, DC resistance, DC resistance unbalance, mutual capacitance, capacitance unbalance, characteristic impedance, structural return loss (SRL), return loss, insertion loss, near-end crosstalk (NEXT) loss, power sum near-end crosstalk (PSNEXT) loss, equal level far-end crosstalk (ELFEXT), power sum equal level far-end crosstalk (PSELFEXT), propagation delay, propagation delay skew and performance marking.

2.8 PAGING SYSTEM CABLE

- A. Provide the following System TIP cables & interconnections:

- 1. Speaker Level (Audio 70.7Volt [V]) Cable, Riser Rated:

- a) For use with 70.7 V audio speaker circuits.
- b) 18 AWG stranded pair, minimum.
- c) UL-1333 listed.

- 2. All cabling shall be plenum rated.

2.9 TESTING DEVICES

- A. Copper tester:

- 1. Test equipment and field test instruments shall meet requirements for ANSI/EIA/TIA-568.
- 2. Store test results, including date stamp of tests and jack designator for each tested link.
- 3. Able to print test results in report form when connected to a PC.

- B. Optical Fiber tester:

4. All testing equipment will test to current ASSI/EIA/TIA standards for both single-mode (9 micrometer), and multi-mode (laser optimized 50 micrometer) fiber specifications.
5. All other parameters shall be equal to those listed within the "Copper tester" entry above.

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 manhole and handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (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 BACKBONE CABLING (COPPER, & OPTICAL FIBER)

- A. All cabling for the backbone infrastructure shall be installed into the cable tray noted on the construction documents. The contractor shall take all steps to ensure that the cabling will not be adversely affected by the placement, or in potential position for damage.
- B. All cabling shall be installed in a manner that is consistent with the installation methods that are noted within the other Division 27 sections.
- C. Installation of the cabling, in addition to the previous note, shall be in compliance with the manufacturer's printed instructions and guidelines, and industry best practices.
- D. All terminations for the cabling shall be done to comply with ANSI/EIA/ TIA-568-B.
- E. Route cable to the termination point using the pre-specified support systems, and in a manner that limits exposure of the cable to potential damage, etc.
- F. Service loops for backbone cabling shall be three (3) meters at each end of the cable run.
- G. All service loops for the copper backbone cabling shall be kept above ceiling, in the nearest adjacent space with an accessible ceiling space, and shall be managed in such a way as to minimize long term risk to the cable.
- H. The service loops for the optical fiber shall be kept within the termination enclosure, routed via the service loop management devices.
- I. Backbone Cable Termination Devices
 - a. Copper termination devices shall be wall-mounted on the plywood backboard within the communications rooms or on the rack in the data center. The contractor shall route the cabling to the appropriate location via ladder rack, and surface mounted (mechanically) d-ring management devices.
 - b. Optical fiber termination devices and enclosures shall be rack mounted within the communications rooms, and shall be installed at RU 45, unless otherwise noted. Dress optical cabling through the rack mounted wire managers as appropriate and position loose fiber strands in enclosure using service loop devices. Close all doors after completing the terminations. Leave fiber connectors with dust

caps in place until such time as the communications rooms are free from contaminants, and/or the Owner commences activating the infrastructure.

J. LABELING & IDENTIFICATION

1. Comply with any Owner directed labeling/ identification methods in conjunction with the above stated information, in addition to any current local, state and national requirements.
2. Labels shall be preprinted or computer-printed type. Labeling ink should not fade or become illegible over time. NO hand printed/ written labeling will be accepted. Contractor will replace labels at no additional cost to the Owner if not installed per the guidelines in these specifications.

K. INFRASTRUCTURE TESTING

1. All testing shall conform to the latest revisions and addendum to the standards referenced within these documents.
2. Copper testing:
 - a. Test 100% of installed backbone copper cabling for:
 - 1) Wire map
 - 2) Length
 - 3) Additional tests for cross-talk, and attenuation as part of best practice for cabling installation testing.
 - b. Replace cable and terminations as necessary to ensure 100% passing performance
 - c. Submit printed test results reports for each copper cabling link to the OAC team before the project is closed. Any cable run that fails testing will be rejected by the OAC team, and will require that the contractor replace and retest at no additional cost.
3. Optical Fiber testing
 - a. Test all fiber optic cable strands for continuity and performance before AND After cables are pulled and terminated.
 - b. Test link attenuation of all installed fiber optic strands after termination in accordance with ANSI/EIA/TIA 568.
 - 1) One (1) direction with an optical light source and an optical power meter.
 - 2) Two (2) wavelengths (850nm and 1300nm) to account for attenuation differences due to wavelength.
 - 3) In accordance with ANSI/EIA/TIA 526, one reference jumper.

- 4) Wrap reference jumper around mandrel to remove high-order mode transient losses as specified in ANSI/ EIA/ TIA 568.

3.9 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. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- D. Section 26 22 00, LOW-VOLTAGE TRANSFORMERS: Low-voltage transformers.
- E. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.
- F. Section 26 36 23, AUTOMATIC TRANSFER SWITCHES: Automatic transfer switches.

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 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 COR.

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):
 - 44-10Thermoset-Insulated Wires and Cables
 - 83-08Thermoplastic-Insulated Wires and Cables
 - 467-07Grounding 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 or insulated stranded copper, except that sizes No. 10 AWG and smaller shall be 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 and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2 GROUND RODS

- A. Steel or 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 CONCRETE ENCASED ELECTRODE

- A. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

2.4 GROUND CONNECTIONS

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

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have

minimum dimensions of 6.3 mm (0.25 inch) thick x 19 mm (0.75 inch) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

2.6 GROUND TERMINAL BLOCKS

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

2.7 GROUNDING BUS BAR

- A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

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. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.
- D. For patient care area electrical power system grounding, conform to NFPA 99 and NEC.

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. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):

1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
 2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.
- C. Switchgear, Switchboards, Unit Substations, Panelboards, Motor Control Centers, Engine-Generators, Automatic Transfer Switches, 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.
- D. Transformers:
1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
 2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system.

3.4 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 an 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. Wireway Systems:

1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).

E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

H. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than No. 10 AWG, installed in rigid metal conduit.

3.5 OUTDOOR METALLIC FENCES AROUND ELECTRICAL EQUIPMENT

- A. 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 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.8 GROUND RESISTANCE

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

3.9 GROUND ROD INSTALLATION

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

3.10 ACCEPTANCE CHECKS AND TESTS

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

---END---

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Section 07 92 00, JOINT SEALANTS: Fabrications for the deflection of water away from the building envelope at penetrations.
- B. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.
- C. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- D. Section 09 91 00, PAINTING: Identification and painting of conduit and other devices.
- E. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- F. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- G. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground conduits.
- H. Section 31 20 11, EARTHWORK: Bedding of conduits.

1.3 QUALITY ASSURANCE

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

1.4 SUBMITTALS

- A. Submit the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. 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 19 mm (0.75-inch) unless otherwise shown. Where permitted by the NEC, 13 mm (0.5-inch) flexible conduit may be used for tap connections to equipment mounted on an acoustic tile ceiling.
- 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. 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.

- 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.
- 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 in addition to where indicated in the Contract Documents.
3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.
4. Minimum size for ceiling mounted boxes for branch circuits is 4-11/16"x2-1/8" Deep.
5. Minimum size for wall mounted boxes for branch circuits is 4"x2-1/8" Deep

F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

2.2 PAD MOUNTED LOW VOLTAGE CABINETS

- A. Free-standing, low profile, rainproof, Type 3R per UL-508.
- B. Steel, 12 gage minimum, door-in-door, polyester powder or weather-resistant paint finish over phosphatized surfaces. Interior white and exterior forest green.
- C. Floor stands with vented skirts to cover space between floor stands. Material and finish to match the panel. Skirts shall be screened to prevent insects and rodents from entering the void.
- D. Exterior gasketed doors with continuous hinge and 3-point handle-operated latching system. Handle with provisions for padlocking; tumbler type lock is not acceptable.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:

1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the COR prior to drilling through structural elements.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except when permitted by the COR 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 92 22, JOINT SEALANTS.
 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.
 4. Surface mounted conduits ran to surface mounted boxes will not be accepted unless a conduit offset is used at the box.
- 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 COR.

3.3 CONCEALED WORK INSTALLATION

- A. In Concrete:
1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
 2. Align and run conduit in direct lines.
 3. Install conduit through concrete beams only:
 - a. Where shown on the structural drawings.
 - b. As approved by the COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
 4. Installation of conduit in concrete that is less than 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, 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. Connect devices mounted to a suspended ceiling with flexible metal conduit. Length shall not exceed 1.8M (6 feet) extending from junction to the termination device.
4. Tightening set screws with pliers is prohibited.
5. 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.
- C. 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 and paint type.
 - a. Conduits used for Fire Alarm circuits and systems shall be Red in color.
 - b. Conduits used for paging, telephone, data and BAS circuits and systems shall be blue in color.
 - c. Conduits which house trunk telephone cables and fiber optics shall be painted orange in color.

3.5 WET OR DAMP LOCATIONS

- A. Use rigid steel conduits unless indicated otherwise.
- 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 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.
- 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.

3.6 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.
- C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.
- D. Maximum length of flexible conduit shall not exceed 4' in length.

3.7 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.

3.8 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.

3.9 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush-mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations 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. On all branch circuit junction box covers, identify the circuits with black marker. Identify the circuit(s) and feeding panelboard(s).

- - - 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. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 31 20 11, EARTHWORK: Trenching, backfill, and compaction.

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 COTR 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: Minimum size as indicated in the Contract Documents, if size is not provided size the box to meet the requirements of the governing codes and standards. 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 22 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.

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. Schedule 80 PVC.
 - b. Duct shall be suitable for use with 75° C (167° F) rated conductors.

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 MANHOLE AND 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.
- C. Grounding in Manholes:
 - 1. Ground Rods in Manholes: Drive a ground rod into the earth, through the floor sleeve, after the manhole is set in place. Fill the sleeve with sealant to make a watertight seal. Rods shall protrude approximately 100 mm (4 inches) above the manhole floor.
 - 2. Install a No. 3/0 AWG bare copper ring grounding conductor around the inside perimeter of the manhole and anchor to the walls with metallic cable clips.
 - 3. Connect the ring grounding conductor to the ground rod by an exothermic welding process.
 - 4. Bond the ring grounding conductor to the duct bank equipment grounding conductors, the exposed non-current carrying metal parts of racks, sump covers, and like items in the manholes with a minimum No. 6 AWG bare copper jumper using an exothermic welding process.

3.2 TRENCHING

- A. Refer to Section 31 20 11, EARTHWORK for trenching, backfilling, and compaction.
- B. 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.

- C. Work with extreme care near existing ducts, conduits, and other utilities to avoid damaging them.
- D. Cut the trenches neatly and uniformly.
- E. 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 COR.

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 COR.

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 Manholes: Ducts connecting to manholes shall be flared to have an enlarged cross-section to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 300 mm (12 inches) in each direction. Perimeter of the duct bank opening in the manhole shall be flared toward the inside or keyed to provide a positive interlock between the duct and the wall of the manhole. Use vibrators when this portion of the encasement is poured to ensure a seal between the envelope and the wall of the structure.

- E. Connections to Existing Manholes: For duct connections to existing manholes, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

- F. 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 COR at no cost to the Government.
4. Mandrel pulls shall be witnessed by the COR.

---END---

SECTION 26 05 73
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the overcurrent protective device coordination study, related calculations and analysis, indicated as the study in this section.
- B. A short-circuit and selective coordination study, and arc flash calculations and analysis shall be prepared for the electrical overcurrent devices to be installed under this project.
- C. The study shall present a well-coordinated time-current analysis of each overcurrent protective device from the individual device up to the utility source and the on-site generator sources.
- D. The study shall be incorporated into the Government's existing software models which are in SKM Power Tools. All labeling shall be provided to match the Government's standard labeling at the St. Cloud, MN campus.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. The study shall be prepared by the equipment manufacturer's qualified engineer(s) or an approved consultant acting under the awarded Contractor. The Contractor is responsible for providing all pertinent information required by the preparers to complete the study.
 - 1. The contractor shall provide any documentation or resume information of a proposed consultant upon request of the COR.
 - 2. COR may provide a list of approved consultants upon request. Allow a minimum of 2-weeks for the COR to provide such list upon request.
- C. Component naming and general one-line methodology shall be consistent with the labels and methods used in the existing software model. The COR may request the contractor to make revisions to the model which are found not to be consistent with the existing conditions at any time

during the project and Contractor must comply at no additional expenses to the Government.

- D. The entire electrical system shall be modeled. This included all equipment that is connected to the electrical service(s) which service any component affected under this project.
 - 1. Include the medium voltage loop components all the back to the Utility Power Company connection points.
 - 2. Include existing and new generator systems.
 - 3. Contractor will not be required to modify any components not modified under this Contract.
 - 4. Contractor may assume the software model provided by the Government has the latest up to date information and is accurate.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Complete study as described in paragraph 1.6. Submittal of the study shall be well-coordinated with submittals of the shop drawings for equipment in related specification sections.
 - 2. Protective equipment shop drawings shall be submitted simultaneously with or after the protective device study. Protective equipment shop drawings will not be accepted prior to protective device study.
 - 3. Contractor shall update the protective device studies with actual field data after the protective equipment has been installed.
 - 4. Two weeks prior to final inspection, submit the following.
 - a. Certification by the Contractor that the overcurrent protective devices have been set in accordance with the approved study.
 - b. Updated software model of the project.
 - c. Hardcopy documents with the updated models, report information and one-line diagrams.
 - d. A feeder schedule listing all conduit and wire sizes between motors, panelboards, switchgear, distribution panels, transformers, generators, transfer switches, safety and disconnect switches/breakers.
 - e. Sample arc flash labels for COR review and comment. COR will review the labels prior to Contractor printing and applying the labels to the equipment. COR reserves the right to request the Contractor to revise component names and tags on the labels. Contractor is required to comply with the requested revisions. If

labels are printed and/or applied prior to COR review, Contractor must remove and replace the labels at no additional expense to the Government.

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. Institute of Electrical and Electronics Engineers (IEEE):
 - 241-90.....Recommended Practice Electrical Systems in Commercial Buildings
 - 242-01.....Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 399-97.....Recommended Practice for Industrial and Commercial Power Systems Analysis
 - 1584-02.....Performing Arc-Flash Hazards Calculations
 - 1584A-04.....Performing Arc-Flash Hazards Calculations - Amendment 1
 - 1584B-11.....Performing Arc-Flash Hazards Calculations - Amendment 2
- C. National Fire Protection Association (NFPA):
 - 70-14.....National Electrical Code (NEC)
 - 70E-15.....Standard for Electrical Safety in the Workplace
 - 99-15.....Health Care Facilities Code

1.6 STUDY REQUIREMENTS

- A. Contractor shall be responsible for providing SKM Power Tools for Windows software and associated software user licenses to complete the study.
- B. The study shall be in accordance with IEEE and NFPA standards.
- C. The study shall include one line diagram, short-circuit and ground fault analysis, protective coordination plots for all overcurrent protective devices, and arc flash calculations and analysis.
- C. One Line Diagram:
 - 1. Show all electrical equipment and wiring to be protected by the overcurrent devices.
 - 2. Show the following specific information:

- a. Calculated fault impedance, X/R ratios, and short-circuit values at each feeder and branch circuit bus.
- b. Relay, circuit breaker, and fuse ratings.
- c. Generator kW/kVA and transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
- d. Voltage at each bus.
- e. Identification of each bus, matching the identification on the drawings.
- f. Conduit, conductor, and busway material, size, length, and X/R ratios.
- g. Arc Flash hazard category and available incident energy at each bus point.

D. Short-Circuit Study:

1. The study shall be performed using computer software designed for this purpose. Pertinent data and the rationale employed in developing the calculations shall be described in the introductory remarks of the study.
2. Calculate the fault impedance to determine the available short-circuit and ground fault currents at each bus. Incorporate applicable motor and/or generator contribution in determining the momentary and interrupting ratings of the overcurrent protective devices.
3. Present the results of the short-circuit study in a table. Include the following:
 - a. Device identification.
 - b. Operating voltage.
 - c. Overcurrent protective device type and rating.
 - d. Calculated short-circuit current.

E. Coordination Study:

1. Prepare the coordination curves to determine the required settings of overcurrent protective devices to demonstrate selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between devices, including the utility company upstream device if applicable. Plot the specific time-current characteristics of each overcurrent protective device in such a manner that all devices are clearly depicted.
2. The following specific information shall also be shown on the coordination curves:

- a. Device identification.
 - b. Potential transformer and current transformer ratios.
 - c. Three-phase and single-phase ANSI damage points or curves for each cable, transformer, or generator.
 - d. Applicable circuit breaker or protective relay characteristic curves.
 - e. No-damage, melting, and clearing curves for fuses.
 - f. Transformer in-rush points.
3. Develop a table to summarize the settings selected for the overcurrent protective devices. Include the following in the table:
- a. Device identification.
 - b. Protective relay or circuit breaker potential and current transformer ratios, sensor rating, and available and suggested pickup and delay settings for each available trip characteristic.
 - c. Fuse rating and type.
 - e. Ground fault pickup and time delay.
- F. Arc Flash Calculations and Analysis:
- 1. Arc flash warning labels shall comply with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 2. Arc flash calculations shall be based on actual over-current protective device clearing time. Maximum clearing time shall be in accordance with IEEE 1584.
 - 3. Arc flash analysis shall be based on the lowest clearing time setting of the over-current protective device to minimize the incident energy level without compromising selective coordination.
 - 4. Arc flash boundary and available arc flash incident energy at the corresponding working distance shall be calculated for all electrical power distribution equipment specified in the project, and as shown on the drawings.
 - 5. Required arc-rated clothing and other PPE shall be selected and specified in accordance with NFPA 70E.

1.7 ANALYSIS

- A. Analyze the short-circuit calculations, and highlight any equipment determined to be underrated as specified. Propose approaches to effectively protect the underrated equipment. Provide minor modifications to conform with the study (examples of minor modifications are trip sizes within the same frame, the time-current curve characteristics of induction relays, CT ranges, etc.).

- B. After developing the coordination curves, highlight areas lacking coordination. Present a technical evaluation with a discussion of the logical compromises for best coordination.
- C. Analyze the arc flash calculations, highlight areas with a hazard category greater than 2. Present a technical evaluation with a discussion of the logical compromises to reduce the hazard to a category 1 or 2.
- D. Study shall include all equipment back to the utility service point, generators serving the project and all equipment between the distribution points (medium and low voltage systems) which may affect the calculations.

1.8 ADJUSTMENTS, SETTINGS AND MODIFICATIONS

- A. Necessary final field adjustments, settings, and minor modifications shall be made by the Contractor to conform with the study without additional cost to the Government.
- B. All final circuit breaker and relay settings and fuse sizes shall be made by the Contractor in accordance with the recommendations of the study.
- C. Settings and equipment sizes shall be provided to minimize the arc flash incident energy levels.

1.9 LABELS

- A. Contractor shall print and apply arc flash hazard labels on all equipment add and/or modified under this project. The label shall meet the St. Cloud, MN campus standards for arc flash labels. The COR will provide the awarded Contractor with a sample label within 2-weeks after a request is made for the label. Contractor shall provide labels which match the size, style, look and information included on the sample label. Below is an example label:

 WARNING	
Arc Flash and Shock Hazard Appropriate PPE Required	
FLASH PROTECTION Hazard/Risk Category 0 Min. Arc Rating: 0.19 cal/cm^2 Flash Protection Boundary: 6 in Glove Class: Leather Gloves Nonmelting or Untreated Fiber with Weight >= 4.5 oz/sq yd	SHOCK PROTECTION Shock Hazard when cover is removed 208 VAC Limited Approach: 42 in Restricted Approach: Avoid Contact Prohibited Approach: Avoid Contact
Isc. 3P: 3.63 kA	
(01) - L11	<small>Warning: Changes in equipment settings or system configuration will invalidate the calculated values and PPE requirements</small>

B. Provide a pdf document with all labels included in this project.

C. Cost of printing and applying all required labels shall be included
in the bid price.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

---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. Section 03 30 53, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.

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. 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.
 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-15.....International Building Code
- C. National Fire Protection Association (NFPA):
70-14.....National Electrical Code (NEC)
- D. National Electrical Manufacturers Association (NEMA):
TR 1-13.....Transformers, Step Voltage Regulators and
Reactors
ST 20-14.....Dry Type Transformers for General Applications
- 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, 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. Average audible sound levels shall comply with NEMA.
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.
 - 1) Openings over vented areas shall not exceed 1" in diameter.
 - 2) Provide a perforated metal enclosure over the vented area.
 - 3) Provide a NEMA 3R louvered drip shield over the perforated area to prevent moisture from entering the openings.
 - 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 energy conservation standards for transformers per the United States Department of Energy's 10 CFR Part 431.

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. Exterior Location: Mount transformers on concrete slab. Provide conduit turn-ups 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 53, 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 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of panelboards.

1.2 RELATED WORK

- A. Section 09 91 00, PAINTING: Painting of panelboards.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:
Low-voltage conductors.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:
Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- F. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY:
Short circuit and coordination study, and requirements for a coordinated electrical system.

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. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.
 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering circuit breakers and replacement parts.

- 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the panelboards.
- 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 panelboards conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the panelboards 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):
 - PB 1-11.....Panelboards
 - 250-08.....Enclosures for Electrical Equipment (1,000V Maximum)
- D. National Fire Protection Association (NFPA):
 - 70-11.....National Electrical Code (NEC)
 - 70E-12.....Standard for Electrical Safety in the Workplace
- E. Underwriters Laboratories, Inc. (UL):
 - 50-95.....Enclosures for Electrical Equipment
 - 67-09.....Panelboards
 - 489-09.....Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.

- B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.
- C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.
- D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.
- E. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
- F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.
- G. Neutral bus shall be 100% rated, mounted on insulated supports.
- H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.
- I. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 22,000 A symmetrical for 120/208 V and 120/240 V panelboards.
- J. Series-rated panelboards are not permitted.

2.2 ENCLOSURES AND TRIMS

- A. Enclosures:
 - 1. Provide painted steel enclosures, with NEMA 3R rating as required for the environmental conditions in which installed.
 - 2. Enclosures shall not have ventilating openings.
 - 3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
 - 4. Provide manufacturer's standard option for prepunched knockouts on top and bottom endwalls.
 - 5. Include removable inner dead front cover, independent of the panelboard cover.
 - 6. Provide floor stand so that the cabinet does not mount directly to the concrete slab. Provide vented skirt over the floor stand opening. Provide screen on opening to prevent insect and rodent entry into the void.
- B. Trims:
 - 1. Hinged "door-in-door" type.

2. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key or tool for entry. Hand-operated latches are not acceptable.
4. Inner and outer doors shall open left to right.
5. Trims shall be flush or surface type as shown on the drawings.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.
- B. Circuit breakers shall be bolt-on type.
- C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
 1. 120/208 V Panelboard: 10,000 A symmetrical.
- D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 100 A frame. Circuit breakers with 100 A frames and above shall have solid state trip unit with adjustable LSI settings. Breaker trip settings shall be set in the field, based on the approved protective device study as specified in Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION.
- E. Circuit breaker features shall be as follows:
 1. A rugged, integral housing of molded insulating material.
 2. Silver alloy contacts.
 3. Arc quenchers and phase barriers for each pole.
 4. Quick-make, quick-break, operating mechanisms.
 5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
 6. Electrically and mechanically trip free.
 7. An operating handle which indicates closed, tripped, and open positions.
 8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
 9. Breakers with a rating of 250A and greater shall be provided with a test injection port. Breakers of smaller sizes shall be provided

with a test injection port if noted elsewhere in the Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- D. Install a printed schedule of circuits in each panelboard after approval by the COR. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards
- E. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).
- F. Provide blank cover for each unused circuit breaker mounting space.
- I. Panelboard enclosures shall not be used for conductors feeding through, spliced, or tapping off to other enclosures or devices.
- J. Panels shall have nameplates identifying panel name, where it is fed from, voltage and feeder conductor sizes.

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 appropriate anchorage and required area clearances.
 - d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
 - e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
 - f. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 FOLLOW-UP VERIFICATION

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

---END---

SECTION 26 36 23
AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of open-transition automatic transfer switches with bypass isolation, indicated as automatic transfer switches or ATS in this section.

1.2 RELATED WORK

- A. Section 03 30 53, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personal safety and to provide a low impedance path for possible ground fault currents.
- E. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- F. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

1.3 QUALITY ASSURANCE

- A. QUALITY ASSURANCE
Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. A factory-authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 4 hours maximum of notification.
- C. Automatic transfer switch, bypass/isolation switch, and annunciation control panels shall be products of the same manufacturer.

1.4 FACTORY TESTS

- A. Automatic transfer switches shall be thoroughly tested at the factory to ensure that there are no electrical or mechanical defects. Tests shall be conducted per UL standards. Factory tests shall be certified, and shall include the following tests:
 - 1. Visual inspection to verify that each ATS is as specified.

2. Mechanical test to verify that ATS sections are free of mechanical hindrances.
 3. Insulation resistance test to ensure electrical integrity and continuity of entire system.
 4. Main switch contact resistance test.
 5. Electrical tests to verify complete system electrical operation.
- B. Furnish four (4) copies of certified manufacturer's factory test reports to the COR prior to shipment of the ATS to ensure that the ATS has been successfully tested as specified.

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. Include voltage rating, continuous current rating, number of phases, withstand and closing rating, dimensions, weights, mounting details, conduit entry provisions, front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, factory relay settings, and accessories.
- c. For automatic transfer switches that are networked together to a common means of annunciation and/or control, submit interconnection diagrams as well as site and building plans, showing connections for normal and emergency sources of power, load, control and annunciation components, and interconnecting communications paths. Equipment locations on the diagrams and plans shall match the site, building, and room designations on the drawings.
- d. Complete nameplate data, including manufacturer's name and catalog number.
- e. A copy of the markings that are to appear on the automatic transfer switches when installed.

2. Manuals:

- a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.

- 1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the automatic transfer switches.
 - 2) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
 - 3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
- 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.
- 1) Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
 - 2) Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
 - 3) The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.
3. Certifications:
- a. When submitting the shop drawings, submit a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008 prototype testing.
 - b. Two weeks prior to final inspection, submit the following.
 - 1) Certification by the manufacturer that the ATS conform to the requirements of the drawings and specifications.
 - 2) Certification by the Contractor that transfer switches 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 referenced in the text by designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE):
- 446-95.....Emergency and Standby Power Systems for
Industrial and Commercial ApplicationsC37.90.1-
02 Surge Withstand Capability (SWC) Tests
for Relays and Relay Systems Associated with
Electric Power Apparatus

- C62.41.1-02.....Guide on the Surges Environment in Low-Voltage
(1000 V and Less) AC Power Circuits
- C62.41.2-02.....Recommended Practice on Characterization of
Surges in Low-Voltage (1000 V and Less) AC
Power Circuits
- C. International Code Council (ICC):
- IBC-12.....International Building Code
- D. National Electrical Manufacturers Association (NEMA):
- 250-08.....Enclosures for Electrical Equipment (1000 Volts
Maximum)
- ICS 6-06.....Enclosures
- ICS 4-10.....Application Guideline for Terminal Blocks
- MG 1-11.....Motors and Generators
- E. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code (NEC)
- 99-12.....Health Care Facilities
- 110-10.....Emergency and Standby Power Systems
- F. Underwriters Laboratories, Inc. (UL):
- 50-95.....Enclosures for Electrical Equipment
- 508-99.....Industrial Control Equipment
- 891-07.....Switchboards
- 1008-07.....Transfer Switch Equipment

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Automatic transfer switches shall comply with UL, NEMA, NEC, ANSI, IEEE, and NFPA, and have the following features:
1. Automatic transfer switches shall be closed transition switches, 4-pole, draw-out construction, electrically operated, mechanically held open contact type, without integral overcurrent protection. Automatic transfer switches utilizing automatic or non-automatic molded case circuit breakers, insulated case circuit breakers, or power circuit breakers as switching mechanisms are not acceptable.
 2. Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.
 3. Ratings:

- a. Phases, voltage, continuous current, poles, and withstand and closing ratings shall be as indicated in the Contract Documents.
 - b. Transfer switches are to be rated for continuous duty at specified continuous current rating on 60Hz systems.
 - c. Minimum automatic transfer switch rating: 400 A.
 - d. 65KAIC rating, minimum.
 - e. Shall have a keyed selector switch to allow the operator to select either closed transition or open transition modes.
Transfer switch shall be initially set to open transition mode.
 - f. All keyed switches and locks shall on the ATS shall be keyed the same.
 - 1) Provide the Government with 4 keys.
4. Markings:
- a. Markings shall be in accordance with UL 1008.
5. Tests:
- a. Automatic transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device and available fault current specified.
6. Surge Withstand Test:
- a. Automatic transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with IEEE C37.90.1.
7. Housing:
- a. Enclose automatic transfer switches in freestanding NEMA 3R painted steel cabinets, with metal gauge not less than No. 14, in accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as indicated in the Contract Documents.
 - b. Enclosure shall be constructed so that personnel are protected from energized components during automatic transfer switch maintenance.
 - c. Automatic transfer switch components shall be removable without disconnecting external source or load power conductors.
 - d. Finish: Cabinets shall be given a phosphate treatment, painted with rust-inhibiting primer, and finish-painted with the manufacturer's standard enamel or lacquer finish. Color to match the other pad mounted cabinets near the ATS.

- e. Viewing Ports: Provide viewing ports so that contacts may be inspected without disassembly.
 - f. Provide floor stands on bottom of enclosure so that cabinet does not sit directly on concrete pad.
 - g. Provide pad lockable handle on the exterior door.
8. Operating Mechanism:
- a. Actuated by an electrical operator.
 - b. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in normal and emergency position.
 - c. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
 - d. Contact transfer time shall not exceed six cycles.
 - e. Operating mechanism components and mechanical interlocks shall be insulated or grounded.
9. Contacts:
- a. Main contacts: Silver alloy.
 - b. Neutral contacts: Silver alloy, with same current rating as phase contacts.
 - c. Current carrying capacity of arcing contacts shall not be used in the determination of the automatic transfer switch rating, and shall be separate from the main contacts.
 - d. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.
10. Manual Operator:
- a. Capable of operation by one person in either direction under no load.
11. Replaceable Parts:
- a. Include the main and arcing contacts individually or as units, as well as relays, and control devices.
 - b. Automatic transfer switch contacts and accessories shall be replaceable from the front without removing the switch from the cabinet and without removing main conductors.
12. Sensing Features:
- a. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be

adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.

- b. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
- c. Voltage/Frequency Lockout Relay: Prevent premature transfer to the engine-generator. Pickup voltage shall be adjustable from 85 to 100% of nominal. Factory set for pickup at 90%. Pickup frequency shall be adjustable from 90 to 100% of nominal. Factory set for pickup at 95%.
- d. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 30 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
- e. Test Switch: Simulate normal-source failure.
- f. Switch-Position Indication: Indicate source to which load is connected.
- g. Source-Available Indication: Supervise sources via transfer switch normal- and emergency-source sensing circuits.
- h. Normal Power Indication: Indicate "Normal Source Available."
- i. Emergency Power Indication: Indicate "Emergency Source Available."
- j. Transfer Override Control: Overrides automatic retransfer control so that automatic transfer switch shall remain connected to emergency power source regardless of condition of normal source. Control panel shall indicate override status.
- k. Engine Starting Contacts: One isolated and normally closed and one isolated and normally open; rated 5 A at 30 V DC minimum.
- l. Engine Shutdown Contacts: Time delay adjustable from zero to 15 minutes, and factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
- m. Engine-Generator Exerciser: Programmable exerciser starts engine-generator(s) and transfers load to them from normal source for a preset time, then retransfers and shuts down engine-generator(s) after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods

are adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period.

- n. Provide the protective relaying and overcurrent features as required by Xcel energy for a closed transition switch and as detailed in the Contract Documents.

13. Controls:

- a. Controls shall provide indication of switch status and be equipped with alarm diagnostics.
- b. Controls shall control operation of the automatic transfer switches.

14. Factory Wiring: Train and bundle factory wiring and label either by color-code or by numbered/lettered wire markers. Labels shall match those on the shop drawings.

16. Auxiliary Contacts:

- a. Provide contacts as necessary to accomplish the functions shown on the drawings, as specified herein, and as designated in other sections of these specifications, as well as one spare normally open contact and one normally closed contact.
- b. Provide remote contact to bypass retransfer time delay to normal source.

17. In-Phase Monitor: Factory-wired, internal relay controls transfer, so that it occurs only when the two sources are synchronized in phase. The relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70% or more of nominal voltage.

B. Manufacturer:

- 1. ASCO 7000
- 2. Or pre-approved equal

2.2 SEQUENCE OF OPERATION

- A. The specified voltage decrease in one or more phases of the normal power source shall initiate the transfer sequence. The automatic transfer switch shall start the engine-generator(s) after a specified

time delay to permit override of momentary dips in the normal power source.

- B. The automatic transfer switch shall transfer the load from normal to emergency source when the frequency and voltage of the engine-generator(s) have attained the specified percent of rated value.
- C. Engine Start: A voltage decrease, at any automatic transfer switch, in one or more phases of the normal power source to less than the specified value of normal shall start the engine-generator(s) after a specified time delay.
- D. Transfer to Emergency System Loads: Automatic transfer switches for Emergency System loads shall transfer their loads from normal to emergency source when frequency and voltage of the engine-generator(s) have attained the specified percent of rated value. Only those switches with deficient normal source voltage shall transfer.
- E. Transfer to Equipment Branch Loads: Automatic transfer switches for Equipment Branch loads shall transfer their loads to the engine-generator on a time-delayed, staggered basis, after the Emergency System switches have transferred. Only those switches with deficient normal source voltage shall transfer.
- F. Retransfer to Normal (All Loads): Automatic transfer switches shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to the specified percent or more of normal voltage, and after a specified time delay. Should the emergency source fail during this time, the automatic transfer switches shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the engine-generator(s) shall continue to run unloaded for a specified interval before shut-down.
- G. The closed transition transfer switch (CTTS) shall transfer the load without interruption (closed transition) by momentarily connecting both sources of power only when both sources are present and acceptable. The maximum interconnection time is 100 milliseconds. The CTTS shall operate as a conventional break-before-make (open transition) switch when the power source serving the load fails.
- H. A potential failure mode is it could be possible that the normal power source and the generator power source stay connected together. There needs to be protection if that type of fault would occur. Parallel operation could be done if one source is a frequency regulator and the

other source shares the load. The load share source would lock into and follow the frequency of the first source. That is not the case here. Both sources are frequency regulators with the generator frequency being set slightly higher. If the sources overlap too long, they would continue to get out of frequency and phase causing severe power quality issues. At some point, one of the circuit breakers may trip on overload but downstream equipment would already have been damaged. The other issue is that a back feed could be seen on the XCEL system.

- I. The transfer switch shall be provided with two levels of protection against this fault.
 1. First, the transfer switch provides its own protection. If the two sources stay in parallel for longer than 100 milliseconds, the last source that was closed will be reopened through an OLC (open last close) relay. The transfer switch will stay on the initial source which could be either normal or generator power. The local buzzer on the transfer switch door will sound. The problem with the transfer switch will need to be resolved and the "Fail to Open Lockout Reset" on the transfer switch digital display would need to be pushed to resume normal operation.
 2. A separate lockout relay circuit provides the next level of protection. This is completely independent of the transfer switch controls and is shown on the attached drawing. If the sources stay in parallel for 500 milliseconds, the lockout relay LOR will trip and will shunt trip the generator breaker. The lockout relay would need to be reset before the circuit breaker could be reset.

J. Circuit Description and Operation

1. The trip circuits for all transfer switches shall be fed from Generator 113VDC battery power. A fuse block is to be provided in the generator east side compartment.
2. A green indicating light on the switch enclosure shall indicate that 24 VDC from the generator batteries is present at the transfer switches. This should be noted during generator testing.
3. Provide a limit switch to be closed if the transfer switch is in the normal position.
4. Provide a limit switch to be closed if the transfer switch is in the generator position.
5. The terminals for these limit switches are to be in the lower cabinet on the left side of the contactor.

6. If both limit switches stay closed, the STT timer contacts will close in 500 milliseconds.
7. Timer STT trips the lockout relay LOR which is located on the inside of the lower compartment door (notice that the LOR trip coil de-energizes after the trip).
8. The lockout relay will have a red flag indicating a trip condition.
9. The LOR contact trips the corresponding circuit breaker in the Generator 113 building.
10. The transfer switch issue needs to be corrected before resetting the lockout relay.
11. The lockout relay needs to be reset before the circuit breaker can be reset.
12. If any of the transfer switch lockout relays trip, a common message shall be sent to Metasys.

2.4 TIME DELAYS

- A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.
 1. Initial delay shall be set to 1 second.
- B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
 1. Initial delay shall be set to 30 minutes.
- C. An adjustable time delay of 0 to 6 seconds to override momentary emergency source outage to delay all retransfer signals during initial loading of engine generator set.
 1. Initial delay shall be set to 1 second.
- D. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
- E. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
 1. Initial delay shall be set to 5 minutes.
- F. A time delay activated output signal shall also be provided to drive an

optional external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:

1. Prior to transfer only.
 2. Prior to and after transfer.
 3. Normal to emergency only.
 4. Emergency to normal only.
 5. Normal to emergency and emergency to normal.
 6. All transfer conditions or only when both sources are available.
- G. The controller shall also include the following built-in time delays for Closed Transition operation:
1. 1 to 5 minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer.
 2. 0.1 to 9.99 second time delay on an extended parallel condition of both power sources during closed transition operation.
- H. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.
- I. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port. The time delay value displayed on the LCD or remote device shall be the remaining time until the next event occurs.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install automatic transfer switches in accordance with the NEC, as indicated in the Contract Documents, and as recommended by the manufacturer.
- B. Anchor automatic transfer switches with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer's instructions, and as shown on drawings.
- C. 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.
- D. Provide all conduit, wire and termination required to complete the operations as specified in the Contract Documents.
- E. Protective relay installation shall be provided to meet the requirements of Xcel Energy.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. An authorized representative of the automatic transfer switch manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the COR. The manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- B. Perform manufacturer's required field 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, electrical, and mechanical condition.
 - c. Confirm correct application of manufacturer's recommended lubricants.
 - d. Verify appropriate anchorage, required area clearances, and correct alignment.
 - e. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
 - f. Verify grounding connections.
 - g. Verify ratings of sensors.
 - h. Vacuum-clean enclosure interior. Clean enclosure exterior.
 - i. Exercise all active components.
 - j. Verify that manual transfer warning signs are properly placed.
 - k. Verify the correct operation of all sensing devices, alarms, and indicating devices.
 - 2. Electrical tests:
 - a. Perform insulation-resistance tests.
 - b. After energizing circuits, demonstrate the interlocking sequence and operational function for each automatic transfer switch at least three times.
 - 1) Test bypass-isolation unit functional modes and related automatic transfer switch operations.
 - 2) Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.

- 3) Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.
 - 4) Low phase-to-ground voltage shall be simulated for each phase of normal source.
 - 5) Operation and settings shall be verified for specified automatic transfer switch operational feature, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
 - 6) Verify pickup and dropout voltages by data readout or inspection of control settings.
 - 7) Verify that bypass and isolation functions perform correctly, including the physical removal of the automatic transfer switch while in bypass mode.
- c. When any defects are detected, correct the defects and repeat the tests as requested by the COR at no additional cost to the Government.

3.3 FIELD SETTINGS VERIFICATION

- A. The automatic transfer switch settings shall be verified in the field by an authorized representative of the manufacturer.

3.4 FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition and properly performing the intended function.

3.5 INSTRUCTION

- A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in the maintenance and operation of the automatic transfer switches, on the dates requested by the COR.

---END---

**SECTION 31 20 11
EARTHWORK (SHORT FORM)**

PART 1 - GENERAL

1.1: DESCRIPTION:

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

1.2 DEFINITIONS:

A. Unsuitable Materials:

1. Fills: Topsoil, frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic materials, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable.
2. Existing Subgrade (except footings): Same materials as above paragraph, that are not capable of direct support of slabs, pavement, and similar items, with the possible exception of improvement by compaction, proofrolling, or similar methods of improvement.
3. Existing Subgrade (footings only): Same as Paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to COR approval.

B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for auxiliary structures and buildings and sewer and other trenchwork throughout the job site.

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

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

1.3 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Safety Requirements : Section 01 35 26, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.

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

D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

1.4 CLASSIFICATION OF EXCAVATION:

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on the surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.
- B. Rock Excavation:
1. Solid ledge rock (igneous, metamorphic, and sedimentary rock).
 2. Bedded or conglomerate deposits so cemented as to present characteristics of solid rock which cannot be excavated without blasting; or the use of a modern power excavator (shovel, backhoe, or similar power excavators) of no less than 0.75 m³ (1 cubic yard) capacity, properly used, having adequate power and in good running condition.
 3. Boulders or other detached stones each having a volume of 0.4 m³ (1/2 cubic yard) or more.

1.5 MEASUREMENT AND PAYMENT FOR EXCAVATION:

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

1.6 MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION:

- A. Measurement: Cross section and measure the uncovered and separated materials, and compute quantities by the Registered Professional Land

Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS. Do not measure quantities beyond the following limits:

1. 300 mm (12 inches) outside of the perimeter of formed footings.
 2. 600 mm (24 inches) outside the face of concrete work for which forms are required, except for footings.
 3. 150 mm (6 inches) below the bottom of pipe and not more than the pipe diameter plus 600 mm (24 inches) in width for pipe trenches.
 4. The outside dimensions of concrete work for which no forms are required (trenches, conduits, and similar items not requiring forms).
- B. Payment for Differing Site Conditions: When rock excavation, as classified, is encountered, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable.

1.7 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Rock Excavation Report:
 1. Certification of rock quantities excavated.
 2. Excavation method.
 3. Labor.
 4. Equipment.
 5. Land Surveyor's or Civil Engineer's name and official registration stamp.
 6. Plot plan showing elevations.
- C. 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.
- D. Furnish to COR , soil samples, suitable for laboratory tests, of proposed off site or on site fill material.
- E. Qualifications of the commercial testing laboratory or Contractor's Testing facility shall be submitted.

1.8 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Nursery and Landscape Association (ANLA):
2004.....American Standard for Nursery Stock
- C. American Association of State Highway and Transportation Officials (AASHTO):
T99-10.....Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop
T180-10.....Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg [10 lb] Rammer and a 457 mm (18 inch) Drop
- D. American Society for Testing and Materials (ASTM):
C33-03.....Concrete Aggregate
D698-e1.....Laboratory Compaction Characteristics of Soil Using Standard Effort
D1140-00.....Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
D1556-00.....Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557-09.....Laboratory Compaction Characteristics of Soil Using Modified Effort
D2167-94 (2001).....Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2487-06.....Standard Classification of Soil for Engineering Purposes (Unified Soil Classification System)
D6938-10.....Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- E. Standard Specifications of Minnesota Department of Transportation 2014 State
Department of Transportation, latest revision.

PART 2 - PRODUCTS**2.1 MATERIALS:**

- A. Fills: Materials approved from on site and off site sources having a minimum dry density of 1760 kg/m³ (110 pcf), a maximum Plasticity Index of 6, and a maximum Liquid Limit of 30.

B. Granular Fill:

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 C33 with a maximum of 3 percent by weight passing ASTM D1140, 75 micrometers (No. 200) sieve, or 37.5 mm (1-1/2 inches) and no more than 2 percent by weight passing the 4.75 mm (No. 4) size sieve or coarse aggregate Size 57, 67, or 77.
2. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No. 4).

C. Fertilizer: (5-10-5) delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.

D. Seed: Grass mixture comparable to existing turf delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.

E. Sod: Comparable species with existing turf. Use State Certified or State Approved sod when available. Deliver sod to site immediately after cutting and in a moist condition. Thickness of cut must be 19 mm to 32 mm (3/4 inch to 1 1/4 inches) excluding top growth. There shall be no broken pads and torn or uneven ends

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

G. Buried Warning and Identification Tape: Polyethylene plastic 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:

Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems

- H. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.076 mm (0.003 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise, and 8.6 MPa (1250 psi) crosswise, with a maximum 350 percent elongation.
- I. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.102 mm (0.004 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise and 8.6 MPa (1250 psi) crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 0.9 m (3 feet) deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.
- J. Detection Wire For Non-Metallic Piping: Detection wire shall be Insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 - EXECUTION

3.1 SITE PREPARATION:

- A. Clearing: Clearing within the limits of earthwork operations as described or designated by the COR. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash and any other obstructions. Remove materials from the Medical Center .
- B. Grubbing: Remove stumps and roots 75 mm (3 inches) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inches) diameter, and

nonperishable solid objects which will be a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left.

- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from the areas within 4500 mm (15 feet) of new construction and 2250 mm (7'-6") of utility lines if such removal is approved in advance by the COR. Remove materials from the Medical Center. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in the construction area. Repair immediately damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including the roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Building materials shall not be stored closer to trees and shrubs that are to remain, than the farthest extension of their limbs.
- D. Stripping Topsoil: Unless otherwise indicated on the drawings, the limits of earthwork operations shall extend anywhere the existing grade is filled or cut or where construction operations have compacted or otherwise disturbed the existing grade or turf. Strip topsoil as defined herein, or as indicated in the geotechnical report, from within the limits of earthwork operations as specified above unless specifically indicated or specified elsewhere in the specifications or shown on the drawings. Topsoil shall be fertile, friable, natural topsoil of loamy character and characteristic of the locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by the COR. Eliminate foreign material, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials, larger than 0.014 m³ (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on the station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work, shall not, under any circumstances, be carried out when the soil is wet so that the tilth of the soil will be destroyed.
- 1. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from the Medical Center.

- E. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations.

3.2 EXCAVATION:

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

maintained continuously, at least 1 m (3.25 feet) 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. Blasting: Blasting shall not be permitted.

D. Building Earthwork:

1. Excavation shall be accomplished as required by drawings and specifications.
2. Excavate foundation excavations to solid undisturbed subgrade.
3. Remove loose or soft material to solid bottom.
4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete, poured separately from the footings.
3. Do not tamp earth for backfilling in footing bottoms, except as specified.

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. The length of open trench in advance of pipe laying shall not be greater than is authorized by the COR.
 - 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. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:
 - 1) Clean, coarsely graded natural gravel, crushed stone or a combination thereof in accordance with DOT State Standard. Maximum particle size shall not exceed 75 mm (3 inches).
2. Sanitary and storm sewer trenches:
- a. Trench width below a point 150 mm (6 inches) above top of the pipe shall be 600 mm (24 inches) for up to and including 300 mm (12 inches) diameter and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (12 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
 - b. The bottom quadrant of the pipe shall be bedded 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 150 mm (6 inches) loose thickness.
 - 1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.
 - 2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one-sixth of pipe diameter below the pipe of 300

mm (12 inches) above top of pipe. Place and tamp fill material by hand.

- c. Place and compact as specified the remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
- d. Use granular fill for bedding where rock or rocky materials are excavated.
- 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. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:
 - 1) Clean, coarsely graded natural gravel, crushed stone or a combination thereof in accordance with DOT State Standard. Maximum particle size shall not exceed 75 mm (3 inches).

F. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials that are determined by the COR as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the Contractor

shall obtain samples of the material, under the direction of the COR, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. Testing of the soil shall be performed by the VA Testing Laboratory. When unsuitable material is encountered and removed, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on meters (yardage) in cut section only.

G. Finished elevation of subgrade shall be as follows:

1. Pavement Areas - bottom of the pavement or base course as applicable.
2. Planting and Lawn Areas - 100 mm (4 inches) below the finished grade, unless otherwise specified or indicated on the drawings.

3.3 FILLING AND BACKFILLING:

- A. General: Do not fill or backfill until all debris, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from the excavation. Proof-roll exposed subgrades with a fully loaded dump truck. Use excavated materials or borrow for fill and backfill, as applicable. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, and pipes coming in contact with backfill have been installed, and inspected and approved by COR.
- B. Placing: Place material in horizontal layers not exceeding 200 mm (8 inches) in loose depth and then compacted. Do not place material on surfaces that are muddy, frozen, or contain frost.
- C. Compaction: Use approved equipment (hand or mechanical) well suited to the type of material being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without the prior approval of the Resident Engineer. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact each layer to not less than 95 percent of the maximum density determined in accordance with the following test method ASTM D698 Method A. Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent

laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure.

- 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 within the limits of the project site, or from approved private sources.

3.4 GRADING:

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In unfinished areas fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside the building away from the building walls for a minimum distance of 3048 mm (10 feet) at a minimum five percent (5%) slope.
- D. The finished grade shall be 150 mm (6 inches) below bottom line of windows or other building wall openings unless greater depth is shown.
- E. Place crushed stone or gravel fill under concrete slabs on grade tamped and leveled. The thickness of the fill shall be 150 mm (6 inches), unless otherwise indicated.
- F. Finish subgrade in a condition acceptable to the Resident Engineer at least one day in advance of the paving operations. Maintain finished subgrade in a smooth and compacted condition until the succeeding operation has been accomplished. Scarify, compact, and grade the subgrade prior to further construction when approved compacted subgrade is disturbed by contractor's subsequent operations or adverse weather.
- G. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.5 LAWN AREAS:

- A. General: Harrow and till to a depth of 100 mm (4 inches), new or existing lawn areas to remain, which are disturbed during construction. Establish existing or design grades by dragging or similar operations. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed. Plant bed must be approved by COR before seeding or sodding operation begins.

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

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL:

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.
- B. Segregate all excavated contaminated soil designated by the COR from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil)

polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

3.7 CLEAN-UP:

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove debris, rubbish, and excess material from the Medical Center.

- - - 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 on the Drawings. Construction shall include the following:
- B. Curb, gutter, and combination curb and gutter .
- C. Pedestrian Pavement: Walks, grade slabs , pedestrian crossings wheelchair curb ramps , steps .
- D. Vehicular Pavement: Driveways , parking lots .
- E. Equipment Pads: Trailer pad.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL CONDITIONS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- C. Section 01 45 29, TESTING LABORATORY SERVICES.
- D. Section 03 30 53, CAST-IN-PLACE CONCRETE.
- E. Section 31 20 11, EARTHWORK (Short Form).

1.3 DESIGN REQUIREMENTS

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

1.4 WEATHER LIMITATIONS

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

1.5 SUBMITTALS

Contractor shall submit the following.

- A. 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
- B. Jointing Plan for all concrete areas.
- C. Concrete Mix Design.
- D. Concrete Test Reports
- E. Construction Staking Notes from Surveyor.
- F. 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

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.

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - M147-65-UL.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)
 - 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
- B. American Society for Testing and Materials (ASTM):
 - A82/A82M-07.....Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
 - A185/185M-07.....Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
 - A615/A615M-12.....Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement

A653/A653M-11.....Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process

A706/A706M-09b.....Standard Specification for Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

A767/A767M-09.....Standard Specification for Zinc Coated (Galvanized) Steel Bars for Concrete Reinforcement

A775/A775M-07b.....Standard Specification for Epoxy Coated Reinforcing Steel Bars

A820/A820M-11.....Standard Specification for Steel Fibers for Fiber Reinforced Concrete

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

C94/C94M-12.....Standard Specification for Ready Mixed Concrete

C143/C143M-10a.....Standard Test Method for Slump of Hydraulic Cement Concrete

C150/C150M-12.....Standard Specification for Portland Cement

C171-07.....Standard Specification for Sheet Materials for Curing 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

C192/C192M-07.....Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

C231/C231M-10.....Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

C260/C260M-10a.....Standard Specification for Air Entraining Admixtures for Concrete

C309-11.....Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete

C494/C494M-12.....Standard Specification for Chemical Admixtures for Concrete

C618-12.....Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C666/C666M-03(2008).....Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

D1751-04(2008).....Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

D4263-83(2012).....Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

D4397-10.....Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications

C. American Welding Society (AWS):

D1.4/D1.4M (2005).....Structural Welding Code - Reinforcing Steel

PART 2 - PRODUCTS

2.1 GENERAL

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

TABLE I - CONCRETE TYPE

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

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

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

TABLE II - MAXIMUM SLUMP - INCHES (MM)

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

2.2 REINFORCEMENT

- A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.

2.3 SELECT SUBBASE (WHERE REQUIRED)

- A. Subbase material shall consist of select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials conforming to AASHTO M147, as follows.

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

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

- B. Materials meeting other gradations than that noted will be acceptable whenever the gradations are within a tolerance of three to five percent, plus or minus, of the single gradation established by the job-mix

formula, or as recommended by the geotechnical engineer and approved by the Resident Engineer.

- C. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

2.4 FORMS

- A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.
- B. Do not use forms if they vary from a straight line more than 1/8 inch (3 mm) in any ten foot (3000 mm) long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 2 inches (50 mm) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.5 CONCRETE CURING MATERIALS

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

2.6 EXPANSION JOINT FILLERS

Material shall conform to ASTM D1751-04.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTHWORK.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.3 SETTING FORMS

- A. Base Support:
 - 1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
 - 2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.
- B. Form Setting:

1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
3. Forms shall conform to line and grade with an allowable tolerance of 1/8 inch (3 mm) when checked with a straightedge and shall not deviate from true line by more than 1/4 inch (6 mm) at any point.
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.
6. Make necessary corrections to forms immediately before placing concrete.
7. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

C. The Contractor's Registered Professional Land Surveyor, specified in Section 01 00 00, GENERAL CONDITIONS, shall establish the control, alignment and the grade elevations of the forms or concrete slipforming machine operations. Staking notes shall be submitted for approval to the Resident Engineer prior to placement of concrete. If discrepancies exist between the field conditions and the Drawings, Contractor shall notify COR immediately. No placement of concrete shall occur if a discrepancy greater than 1 inch (25 mm) is discovered.

3.4 EQUIPMENT

- A. The COR shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

3.5 PLACING REINFORCEMENT

- A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement. All reinforcement shall be supported for proper placement within the concrete section.
- B. Before the concrete is placed, the COR shall approve the reinforcement placement, which shall be accurately and securely fastened in place with

suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown on the Drawings.

3.6 PLACING CONCRETE - GENERAL

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

3.7 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

3.8 PLACING CONCRETE FOR VEHICULAR PAVEMENT

- A. Deposit concrete into the forms as close as possible to its final position.
- B. Place concrete rapidly and continuously between construction joints.
- C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.
- D. Finish the surface to the elevation and crown as shown.
- E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes without approval by the Resident Engineer.

3.9 CONCRETE FINISHING - GENERAL

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
 - 1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
 - 2. Maintain finishing equipment and tools in a clean and approved condition.

3.10 CONCRETE FINISHING CURB AND GUTTER

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

3.11 CONCRETE FINISHING PEDESTRIAN PAVEMENT

A. Walks, Grade Slabs, Wheelchair Curb Ramps, :

1. Finish the surfaces to grade and cross section with a metal float, troweled 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 (2 mm) 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 (5 mm) when tested with a 10 foot (3000 mm) straightedge.
6. The thickness of the pavement shall not vary more than 1/4 inch (6 mm).
7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints at no additional cost to the Government.

B. Steps: The method of finishing the steps and the sidewalls is similar to above except as herein noted.

1. Remove the riser forms one at a time, starting with the top riser.
2. After removing the riser form, rub the face of the riser with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Use an outside edger to round the corner of the tread; use an inside edger to finish the corner at the bottom of the riser.
3. Give the risers and sidewall a final brush finish. The treads shall have a final finish with a stiff brush to provide a non-slip surface.
4. The texture of the completed steps shall present a neat and uniform appearance and shall not deviate from a straightedge test more than 3/16 inch (5 mm).

3.12 CONCRETE FINISHING FOR VEHICULAR PAVEMENT

- #### A. Accomplish longitudinal floating with a longitudinal float not less than 10 feet (3000 mm) long and 6 inches (150 mm) wide, properly stiffened to prevent flexing and warping. Operate the float from foot bridges in a sawing motion parallel to the direction in which the pavement is being

laid from one side of the pavement to the other, and advancing not more than half the length of the float.

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

3.13 CONCRETE FINISHING EQUIPMENT PADS

- A. After the surface has been struck off and screeded to the proper elevation, provide a smooth dense float finish, free from depressions or irregularities.
- B. Carefully finish all slab edges with an edger having a radius as shown in the Drawings.
- C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary

more than 1/8 inch (3 mm) when tested with a 10 foot (3000 mm) straightedge.

- D. Correct irregularities exceeding the above. See Article 3.6, Paragraph H, above.

3.14 JOINTS - GENERAL

- A. Place joints, where shown on the Shop Drawings and Drawings, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.
- B. Joints shall be straight and continuous from edge to edge of the pavement.

3.15 CONTRACTION JOINTS

- A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown or by sawing with a blade producing the required width and depth.
- B. Construct joints in curbs and gutters by inserting 1/8 inch (3 mm) steel plates conforming to the cross sections of the curb and gutter.
- C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.
- D. Finish edges of all joints with an edging tool having the radius as shown.
- E. Score pedestrian pavement with a standard grooving tool or jointer.

3.16 EXPANSION JOINTS

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
 2. Using joint filler of the type, thickness, and width as shown.
 3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.17 CONSTRUCTION JOINTS

- A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as shown on the Shop Drawing jointing plan and Drawings.
- 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 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 joint interval.

3.18 FORM REMOVAL

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

3.20 CURING OF CONCRETE

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

1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 200 square feet per gallon (5 m²/L) for both coats.
2. Do not allow the concrete to dry before the application of the membrane.
3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

3.21 CLEANING

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

3.22 PROTECTION

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the Resident Engineer, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the Resident Engineer.

3.23 FINAL CLEAN-UP

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

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SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.2 RELATED WORK

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 11, EARTH MOVING.

1.3 INSPECTION OF PLANT AND EQUIPMENT

The COR shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

1.4 ALIGNMENT AND GRADE CONTROL

The Contractor's Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Data and Test Reports:
 - 1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
 - 2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.
 - 3. Job-mix formula.
- C. Certifications:

1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
2. Asphalt cement certificate of conformance to State Highway Department requirements.
3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification.
- D. One copy of State Highway Department Specifications.
- E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Aggregate base and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the State Highway Material Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA COR.
- B. Non-wearing Course: SPNW3330B.
- C. Wearing Course: SPWE2340B.
 1. No RAP will be allowed in the bituminous wearing course.

2.2 AGGREGATES

- A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.
- B. Subbase aggregate (where required) maximum size: 38mm(1-1/2").
- C. Base aggregate maximum size:
 1. Base course over 152mm(6") thick: 38mm(1-1/2");
 2. Other base courses: 19mm(3/4").
- D. Asphaltic base course:
 1. Maximum particle size not to exceed 25.4mm(1").
 2. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.
- E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

Sieve Sizes

Percentage Passing

32 12 16 - 2

Project No. 656-15-267

19mm (3/4")	100
9.5mm (3/8")	67 to 85
6.4mm (1/4")	50 to 65
2.4mm (No. 8 mesh)	37 to 50
600µm (No. 30 mesh)	15 to 25
75µm (No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

2.3 ASPHALTS

A. Comply with provisions of Asphalt Institute Specification SS2:

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

2.4 SEALER

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

PART 3 - EXECUTION

3.1 GENERAL

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

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

- A. Provide hot plant-mixed asphaltic concrete paving materials.
1. Temperature leaving the plant: 143 degrees C (290 degrees F) minimum, 160 degrees C (320 degrees F) maximum.
 2. Temperature at time of placing: 138 degrees C (280 degrees F) minimum.

3.3 SUBGRADE

- A. Shape to line and grade and compact with self-propelled rollers.

- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by the COR. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

- A. Subbase (when required)
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.
- B. Base
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (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 Engineer.
- C. Receipt of asphaltic concrete materials:

1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 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 Engineer.
- B. Apply one coat of the specified sealer.
- C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

3.7 PROTECTION

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

3.8 FINAL CLEAN-UP

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

- - - 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 Officer 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-1952D.....Paint, Traffic Black, and Airfield Marking,
Waterborne
- C. Master Painters Institute (MPI):
- Approved Product List - 2010

PART 2 - PRODUCTS

2.1 PAINT

Paint for marking pavement (parking lot and zone marking) shall conform to MPI No. 97, color as shown. Paint for obliterating existing markings shall conform to Fed. Spec. TT-P-1952D. Paint shall be in containers of at least 18 L (5 gallons). A certificate shall accompany each batch of paint stating compliance with the applicable publication.

2.2 REFLECTIVE GLASS BEADS

Beads shall conform to Fed. Spec. TT-B-1325C, Type I, 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 m³/s (150 cfm) of air at a pressure of not less than 625 kPa (90 psi) at each nozzle used.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by the 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 Officer 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 FINAL CLEAN-UP

Remove all debris, rubbish and excess material.

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SECTION 32 90 00**PLANTING****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. The work in this section consists of furnishing and installing plant, soils, edging turf, grasses and landscape materials required as specified in locations shown.

1.2 RELATED WORK

- A. Topsoil Testing: Section 01 45 29, TESTING LABORATORY SERVICES.
B. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
C. Stripping Topsoil, Stock Piling and Topsoil Materials: Section 31 20 11, EARTH MOVING.

1.3 DEFINITIONS

- A. Backfill: The earth used to replace earth in an excavation.
B. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
C. Finish Grade: Elevation of finished surface of planting soil.
D. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
E. Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, turf and grasses, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
F. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 ABBREVIATIONS

1.5 DELIVERY, STORAGE AND HANDLING

A. Notify the COR of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant and landscape materials from the job site immediately.

B. Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable. Keep seed and other packaged materials in dry storage away from contaminants.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants. Keep bulk materials in dry storage away from contaminants.
2. Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

D. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

E. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

F. Handle planting stock by root ball.

- G. The use of equipment such as "tree spades" is permitted provided the plant balls are sized in accordance with ANSI Z60.1 and tops are protected from damage.
- H. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.
- I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than 6 hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock: Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
 - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet, condition.
- J. Harvest, deliver, store, and handle sod according to requirements in TPI's "Guideline Specifications to Turfgrass Sodding". Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage, seed contamination and drying.
- K. Deliver sprigs in air tight bags to keep from drying out. Sprigs delivered unwrapped, shall be kept moist in burlap or other accepted material until planting.
- L. Deliver plugs within 24 hours of harvesting, keep moist until planting.
- M. All pesticides and herbicides shall be properly labeled and registered with the U.S. Department of Agriculture. Deliver materials in original, unopened containers showing, certified analysis, name and address of manufacturer, product label, manufacturer's application instructions specific to the project and indication of conformance with state and federal laws, as applicable.

1.6 PROJECT CONDITIONS

- A. Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and

construction contiguous with new plantings by field measurements before proceeding with planting work.

- B. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion. Plant during one of the following periods:
 - 1. Spring Planting: April 1 to June 1
 - 2. Fall Planting: July 20 to Sept 20
- C. Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- D. Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.
- E. Plant trees, shrubs, and other plants after finish grades and irrigation system components are established.
 - 1. When planting trees, shrubs, and other plants, protect irrigation system components and promptly repair damage caused by planting operations.

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. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association with 3 years experience in landscape installation.
2. Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
3. Installer's personnel assigned to the Work shall have certification in one of the following categories from the Professional Landcare Network and submit one copy of certificate to the COR:
 - a. Certified Landscape Technician (CLT) - Exterior, with installation designated CLT-Exterior.
 - b. Certified Ornamental Landscape Professional, designated COLP.
4. Pesticide Applicator: Licensed in state of project, commercial.
- C. A qualified Arborist shall be licensed and required to submit one copy of license to the COR.
- D. Include an independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- E. For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
 1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60, "Diagnosis and Improvement of Saline and Alkali Soils".
 2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from COR. A minimum of 3 representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
 3. Report suitability of tested soil for plant growth.
 - a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd (0.76 cu. m) for nitrogen, phosphorus, and potash

nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

- b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
- F. Provide quality, size, genus, species, variety and sources of plants indicated, complying with applicable requirements in ANSI Z60.1.
- G. Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
 - 1. Measure trees and shrubs with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4 inch (100 mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
 - 2. Measure other plants with stems, petioles, and foliage in their normal position.
- H. COR may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Contracting Officer's Representative retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 - 1. Notify COR of plant material sources seven days in advance of delivery to site.
- I. Include product label and manufacturer's literature and data for pesticides and herbicides.
- J. Conduct a pre-installation conference at Project site.

1.8 SUBMITTALS

- A. Submit product data for each type of product indicated, including soils:
 - 1. Include quantities, sizes, quality, and sources for plant materials.
 - 2. Include EPA approved product label, MSDS (Material Safety Data Sheet) and manufacturer's application instructions specific to the Project.

3. Include color photographs in 3 by 5 inch (76 by 127 mm) print format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of 3 photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- B. Submit samples and manufacturer's literature for each of the following for approval before work is started.
 1. Trees and Shrubs: 1 sample of each variety and size delivered to the site for review. Maintain approved samples on-site as a standard for comparison.
- C. capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- D. Prior to delivery, provide notarized certificates attesting that each type of manufactured product, from the manufacturer, meet the requirements specified and shall be submitted to the COR for approval:
 1. Plant Materials (Department of Agriculture certification by State Nursery Inspector declaring material to be free from insects and disease).
 2. Seed and Turf Materials notarized certificate of product analysis.
 3. Manufacturer's certified analysis of standard products.
 4. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Material Test Reports: For existing native surface topsoil existing in-place surface soil and imported or manufactured topsoil.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

1.9 PLANT AND TURF ESTABLISHMENT PERIOD

- A. The establishment period for plants and turf shall begin immediately after installation, with the approval of the COR, and continue until the

date that the Government accepts the project or phase for beneficial use and occupancy. During the Establishment Period the Contractor shall maintain the plants and turf as required in Part 3.

1.10 PLANT AND TURF MAINTENANCE SERVICE

A. Provide initial maintenance service for trees, shrubs, ground cover and other plants by skilled employees of landscape Installer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 3 months from date of Substantial Completion.

B. Obtain continuing maintenance proposal from Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.11 APPLICABLE PUBLICATIONS

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

B. American National Standards Institute (ANSI):

Z60.1-04.....Nursery Stock

C. Association of Official Seed Analysts (AOSA): Rules for Testing Seed.

D. American Society For Testing And Materials (ASTM):

B221-08.....Aluminum and Aluminum-Alloy Extruded Bars,
Rods, Wire, Profiles, and Tubes

C33/C33M-11.....Concrete Aggregates

C136-06.....Sieve Analysis of Fine and Coarse Aggregates

C516-08.....Vermiculite Loose Fill Thermal Insulation

C549-06.....Perlite Loose Fill Insulation

C602-07.....Agricultural Liming Materials

D977-05.....Emulsified Asphalt (AASHTO M140)

D5268-07.....Topsoil Used for Landscaping Purposes

- E. Hortus Third: A Concise Dictionary of Plants Cultivated in the United States and Canada.
- F. Turfgrass Producers International (TPI): Guideline Specifications to Turfgrass Sodding.
- G. United States Department of Agriculture (USDA): Handbook No. 60 Diagnosis and Improvement of Saline and Alkali Soils; Federal Seed Act Regulations.

1.12 WARRANTY

- A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance, unless noted otherwise below. Further, the Contractor will provide all manufacturer's and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.
 - 1. Plant and Turf Warranty Periods will begin from the date of Government acceptance of the project or phase for beneficial use and occupancy.
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers, Biennials, Perennials, Turf, and Other Plants: 12 months.
 - 2. The Contractor shall have completed, located, and installed all plants and turf according to the plans and specifications. All plants and turf are expected to be living and in a healthy condition at the time of final inspection.
 - 3. The Contractor will replace any dead plant material and any areas void of turf immediately, unless required to plant in the succeeding planting season. Provide extended warranty for period equal to original warranty period for replacement plant materials. Replacement plant and turf warranty will begin on the day the work is completed.
 - 4. Replacement of relocated plants, that the Contractor did not supply, is not required unless plant failure is due to improper handling and care during transplanting. Loss through Contractor negligence requires replacement in plant type and size.
 - 5. The Government will reinspect all plants and turf at the end of the Warranty Period. The Contractor will replace any dead, missing, or defective plant material and turf immediately. The Warranty Period

will end on the date of this inspection provided the Contractor has complied with the warranty work required by this specification. The Contractor shall also comply with the following requirements:

- a. Replace plants that are more than 25 percent dead, missing or defective plant material prior to final inspection.
 - b. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
 - c. Mulch and weed plant beds and saucers. Just prior to final inspection, treat these areas to a second application of approved pre-emergent herbicide.
 - d. Complete remedial measures directed by the COR to ensure plant and turf survival.
 - e. Repair damage caused while making plant or turf replacements.
- B. Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
- 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. Plant and turf materials: ANSI Z60.1; will conform to the varieties specified and be true to botanical name as listed in Hortus Third; nursery-grown plants and turf material true to genus, species, variety, cultivar, stem form, shearing, and other features indicated on Drawings; healthy, normal and unbroken root systems developed by transplanting or root pruning; well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf; free of disease, pests, eggs, larvae, and defects such as knots, sun scald, windburn, injuries, abrasions, and disfigurement.

1. Trees-deciduous and evergreen: Single trunked with a single leader, unless otherwise indicated; symmetrically developed deciduous trees and shrubs of uniform habit of growth; straight boles or stems; free from objectionable disfigurements; evergreen trees and shrubs with well developed symmetrical tops, with typical spread of branches for each particular species or variety. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots will be rejected.
2. Ground cover and vine plants: Provide the number and length of runners for the size specified on the Drawings, together with the proper age for the grade of plants specified. Provide vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections. Plants shall have been grown under climatic conditions similar to those in the locality of the project. Spray all plants budding into leaf or having soft growth with an anti desiccant at the nursery before digging.
3. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the COR, with no change in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.
4. Provide nursery grown plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting.
5. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
6. Make substitutions only when a plant (or alternates as specified) is not obtainable and the COR authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant

with the same essential characteristics and an equitable adjustment of the contract price.

7. Existing plants to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.
8. Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Label at least one plant of each variety, size, and caliper with a securely attached, waterproof and weather-resistant label bearing legible the correct designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as indicated in the Plant Schedule or Plant Legend shown on the Drawings. Labels shall be securely attached and not be removed.

2.2 PLANT AND TURF FERTILIZERS

- A. Soil Test: Evaluate existing soil conditions and requirements prior to fertilizer selection and application to minimize the use of all fertilizers and chemical products. Obtain approval of COR for allowable products, product alternatives, scheduling and application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions according to manufacturer's written instructions and warranty requirements. Fertilizers to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer applicable to specific areas as required for Project conditions and application. Provide commercial grade plant and turf fertilizers, free flowing, uniform in composition and conforms to applicable state and federal regulations.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

C. Slow-Release Fertilizer: Granular or pellet fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Plant Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break

2.3 PLANTING SOILS

A. Planting Soil: ASTM D5268 topsoil, with pH range of 5.5 to 7, a minimum of 4percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D5268 topsoil with the following soil amendments and fertilizers as recommended by the soils analysis.

B. Existing Planting Soil: Existing, native surface topsoil formed under natural conditions retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

1. Supplement with planting soil when quantities are insufficient.
2. Mix existing, native surface topsoil with the following soil amendments and fertilizers as recommended by the soils analysis.

C. Imported Planting Soil: Imported topsoil or manufactured topsoil from off-site sources can be used if sufficient topsoil is not available on site to meet the depth as specified herein. The Contractor shall furnish imported topsoil. At least 10 days prior to topsoil delivery, notify the COR of the source(s) from which topsoil is to be furnished. Obtain imported topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs, or marshes.

2.4 LANDSCAPE MEMBRANES

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101 g/sq. m) minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally-encountered chemicals, alkalis, and acids.

- B. Composite Fabric shall be woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd. (162 g/sq. m).

2.5 TACKIFIERS AND ADHESIVES

- A. Nonasphalt tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- B. Asphalt emulsion: ASTM D977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.6 EROSION CONTROL

- A. Erosion control blankets: Must be MnDot Spec 3885 category 0 erosion control blanket.
- B. No fiber mesh allowed. Include manufacturer's recommended biodegradable staples, 6 inches (150 mm) long.

2.7 WATER

- A. Water shall not contain elements toxic to plant life. Water to be supplied by contractor at no cost to the Government.

2.8 TURF SELECTIONS

- A. Grasses for Cool Regions shall be:
 1. Bentgrasses: Redtop (*Agrostis alba*) & Colonial (*Agrostis tenuis*)
 2. Bluegrasses: Kentucky (*Poa pratensis*), Rough-stalked (*Poa trivialis*) & Canada (*Poa compressa*)
 3. Fescue: Red (*Festuca rubra*), Meadow (*Festuca pratensis*) & Tall (*Festuca arundinacea*)
 4. Ryegrasses: Perennial (*Lolium perenne*)

2.9 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with "AOSA, Rules for Testing Seed" for purity and germination tolerances. Seed shall be labeled in conformance with U. S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will not be acceptable.
- B. Seed Species: Not less than 95 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed.

PART 3 - EXECUTION**3.1 EXAMINATION**

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

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain approval by the Contracting Officer's Representative of layout before excavating or planting. The COR may

approve adjustments to plant material locations to meet field conditions.

- D. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 12 inches. Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer directly to subgrade before loosening.
 - 2. Thoroughly blend planting soil off-site before spreading spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 - 3. Spread planting soil to a depth of 12 inches (300 mm) but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, obtain COR acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Prior to planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.
 1. Use planting soil for backfill.
 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Set container-grown stock plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.
 1. Use planting soil for backfill.
 2. Carefully remove root ball from container without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately

- one-half full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. Set and support bare-root stock in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grade.
1. Use planting soil for backfill.
 2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.
 3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.
 4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- F. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 GROUND COVER AND PLANT INSTALLATION

- A. Set out and space ground cover and plants other than trees, shrubs, and vines 18 inches apart in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.

- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.
- H. Plant ground cover in areas to receive erosion control materials through the material after erosion control materials are in place.

3.7 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring plant saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.8 TURF AREA PREPARATION AND GRADING

- A. For newly graded subgrades loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer directly to subgrade before loosening, at rates recommended by the soils analysis.
 - 2. Spread topsoil, apply fertilizer on surface, and thoroughly blend planting soil.
 - 3. Spread planting soil to a depth of 8 inches (200 mm) but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

- a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil.
 - b. Reduce elevation of planting soil to allow for soil thickness of sod.
- B. Finish grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

3.9 PREPARATION FOR EROSION-CONTROL MATERIALS.

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

3.10 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 2 lb/1000 sq. ft. (0.9 kg/92.9 sq. m).
- C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

- D. Protect seeded areas with slopes exceeding 1:6 with erosion-control fiber mesh installed and fastened with biodegradable materials according to manufacturer's written instructions.
- E. Protect seeded areas with erosion control mats where shown on Drawings; install and anchor with biodegradable materials according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket // 1-1/2 inches (38 mm) in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

3.11 TURF MAINTENANCE

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

3.12 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by COR:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).

3.13 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- D. Erect temporary fencing or barricades and warning signs, as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- E. After installation and before Substantial Completion remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- F. Remove nondegradable erosion control measures after grass establishment period.

G. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

--- END ---

SECTION 33 10 00
WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of underground water distribution for domestic and/or fire supply systems outside the building that are complete and ready for operation. This includes piping, structures, appurtenances and all other incidentals.

1.2 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 11, EARTH MOVING.
- B. Concrete: Section 03 30 53, CAST IN-PLACE CONCRETE.
- C. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- D. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.3 DEFINITIONS

- A. Water distribution system: Pipelines and appurtenances which are part of the distribution system outside the building for potable water and fire supply.
- B. Water service line: Pipeline from main line to 5 feet outside of building.

1.4 ABBREVIATIONS

- A. PVC: Polyvinyl chloride plastic.
- B. DI: Ductile iron pipe.
- C. WOG: Water, Oil and Gas.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Ensure that valves are dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends and flange faces.
- B. Use a sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

- C. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- D. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.
- E. Store plastic piping protected from direct sunlight and support to prevent sagging and bending.
- F. Cleanliness of Piping and Equipment Systems:
 - 1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
 - 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

1.6 COORDINATION

- A. Coordinate connection to water main with VA.
- B. Coordinate water service lines with building contractor.

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. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least three years. Digital electronic devices, software and systems such as controls, instruments or computer work stations shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years.
- C. Regulatory requirements:
 - 1. Comply with the rules and regulations of the public utility company having jurisdiction over the connection to public water lines and the extension and/or modifications to public utility systems.

2. Comply with the rules and regulations of the State Health Department having jurisdiction for potable water-service.
3. Comply with rules and regulations of Federal, State, and Local authorities having jurisdiction for fire-suppression water-service piping including materials, hose threads, installation and testing.
- D. Provide certification of factory hydrostatic testing of not less than 500 psi (3.5 MPa) in accordance with AWWA C151. Piping materials shall bear the label, stamp or other markings of the specified testing agency.
- E. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COR prior to installation.
- F. Applicable codes:
 1. Plumbing Systems: IPC, International Plumbing Code.
 2. Electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
 3. Fire-service main products shall be listed in the FM Global "Approval Guide" or Underwriters Laboratories (UL) "Fire Protection Equipment Directory".

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):
 - B88/B88M-09.....Seamless Copper Water Tube
 - C651-05.....Disinfecting Water Mains
 - C858-10e1.....Underground Precast Utility Structures
 - D1785-06.....Poly (Vinyl Chloride) (PVC) Plastic Pipe,
Schedules 40, 80, and 120
 - D2239-03.....Polyethylene (PE) Plastic Pipe (SIDR-PR) Based
on Controlled Inside Diameter
 - D2466-06.....Poly (Vinyl Chloride) (PVC) Pipe Fittings,
Schedule 40

D3350-10a.....Polyethylene Plastics Pipe and Fittings
Materials

F714-10.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based
on Outside Diameter

F1267-07.....Metal, Expanded, Steel

C. American Water Works Association (AWWA):

B300-10.....Hypochlorites

B301-10.....Liquid Chlorine

C104-08.....Cement-Mortar Lining for Ductile Iron Pipe and
Fittings

C105/A21.5-10.....Polyethylene Encasement for Ductile Iron Pipe
Systems

C110-08.....Ductile Iron and Gray-Iron Fittings

C111/A21.11-07.....Rubber-Gasket Joints for Ductile Iron Pressure
Pipe and Fittings

C151/A21.51-09.....Ductile Iron Pipe, Centrifugally Cast

C153/A21.53-11.....Ductile Iron Compact Fittings for Water Service

C502-05.....Dry-Barrel Fire Hydrants

C503-05.....Wet-Barrel Fire Hydrants

C509-09.....Resilient-Seated Gate Valves for Water Supply
Service

C550-05.....Protective Interior Coatings for Valves and
Hydrants

C600-10.....Installation of Ductile Iron Mains and Their
Appurtenances

C605-11.....Underground Installation of Polyvinyl Chloride
(PVC) Pressure Pipe and Fittings for Water

C606-11.....Grooved and Shouldered Joints

C651-05.....Disinfecting Water Mains

- C700-09.....Cold-Water Meters, "Displacement Type," Bronze
Main Case
- C800-05.....Underground Service Line Valves and Fittings
- C900-09.....Polyvinyl Chloride (PVC) Pressure Pipe and
Fabricated Fittings, 4 In. Through 12 In. (100
mm Through 300 mm), for Water Transmission and
Distribution
- C907-04.....Injection-Molded PVC Pressure Fittings, 4 Inch
through 12 Inch (100 mm through 300 mm), for
Water Distribution
- M23-2nd Ed.....PVC Pipe, Design and Installation
- M44-2nd Ed.....Distribution Valves: Selection, Installation,
Field Testing and Maintenance
- D. National Fire Protection Association (NFPA):
- NFPA 24-2010 Ed.....Installation of Private Fire Service Mains and
Their Appurtenances
- NFPA 1963-2009 Ed.....Fire Hose Connections
- E. NSF International (NSF):
- NSF/ANSI 14 (2013).....Plastics Piping System Components and Related
Materials
- NSF/ANSI 61-2012.....Drinking Water System Components - Health
Effects
- NSF/ANSI 372-2011.....Drinking Water System Components - Lead Content
- 405.....Fire Department Connection Devices
- 753.....Alarm Accessories for Automatic Water-Supply
Control Valves for Fire Protection Service
- 1285.....Pipe and Couplings, Polyvinyl Chloride (PVC),
and Oriented Polyvinyl Chloride (PVC0) for
Underground Fire Service

1.9 WARRANTY

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

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61 or NSF 372.
- B. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended.

2.2 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.

2.3 SAFETY GUARDS**2.4 DUCTILE IRON PIPE AND FITTINGS**

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated, 350 psi (2400 kPa).
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated, 350 psi (2400 kPa).
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.

C. Cement Mortar Internal Lining: Cement mortar lining and bituminous seal coat as per AWWA C104.

D. Exterior Pipe Coating: The exterior of pipe shall have the standard asphaltic coating.

2.5 POLYVINYL CHLORIDE PIPE AND FITTINGS

A. PVC, AWWA Pipe: AWWA C900, with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.

2. PVC Fabricated Fittings: AWWA C900, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

3. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.

a. Gaskets: AWWA C111, rubber.

4. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.6 PE PIPE AND FITTINGS

A. PE, ASTM Pipe: ASTM D2239, SDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 200 psi (1380 kPa).

1. Insert Fittings for PE Pipe: ASTM D2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.

2. Molded PE Fittings: ASTM D3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 200 psi (1380 kPa).

1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 200 psi (1380 kPa).

2.7 COPPER TUBE AND FITTINGS

A. Soft Copper Tubing: ASTM B88, Type K water tube, annealed temper.

2.8 VALVES

A. Gate Valves: AWWA C509, Non-rising Stem, Resilient Seat, 200 psi (1380 kPa).

1. Valves 3 inches (75 mm) and larger: Resilient seat valve with gray- or ductile iron body and bonnet; cast iron or bronze double-disc gate; bronze gate rings; non-rising bronze stem and stem nut.
2. Interior and exterior coating: AWWA C550, thermo-setting or fusion epoxy.
3. Underground valve nut: Furnish valves with 2 inch (50 mm) nut for socket wrench operation.
4. Aboveground and pit operation: Furnish valves with hand wheels.
5. End connections shall be mechanical joint.

B. Gate Valve Accessories and Specialties

1. Tapping-Sleeve Assembly: ANSI MSS SP-60; sleeve and valve to be compatible with the drilling matching.
 - a. Tapping Sleeve: Ductile Iron, two-piece bolted sleeve. Sleeve to match the size and type of pipe material being tapped.
 - b. Valve shall include one raised face flange mating tapping-sleeve flange.
2. Valve Boxes: AWWA M44 with top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel.
3. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut. (Provide two wrenches for Project.)
4. Indicator Posts: UL 789, FMG approved, vertical-type, cast iron body with operating wrench, extension rod, and adjustable cast iron barrel of length required for depth of burial of valve.

C. Swing Check Valves:

1. Valves smaller than 2 inches (25 mm): ASTM B61, resilient seat, bronze body and bonnet, pressure rating of 200 psi (1380 kPa). Ends to match main line piping.
2. Valves 2 inches (25 mm) or larger: AWWA 508, resilient seat valve with iron body and bonnet, pressure rating of 200 psi (1380 kPa).
3. Coating: AWWA C550, fusion epoxy coated.

D. Detector Check Valves

E. Butterfly Valves

- F. Plug Valves: ANSI MSS SP-108, resilient-seated eccentric plug valve, minimum pressure of 175 psi (1207 kPa).

G. Corporation Valves and Curb Valves

1. Service-Saddle Assemblies: AWWA C800.

a. Service Saddle: Copper alloy with seal and threaded outlet for corporation valve.

b. Corporation Valve: Bronze body and ground-key plug, with threaded inlet and outlet matching service piping material.

2. Curb Valves: AWWA C800, bronze body, ground-key plug or ball, wide tee head, with inlet and outlet matching service piping material, minimum pressure of 200 psi (1375 kPa). Curb valve shall be Ford BC22-444SW-NL or approved equal.

3. Service Boxes for Curb Valves: AWWA M44, cast iron telescoping top section; plug shall include lettering "WATER"; bottom section with base that fits over curb valve.

4. Shutoff Rods: Steel, tee-handle with one pointed end. Stem length shall extend 2 feet (600 mm) above top of valve box for operation of deepest buried valve, with slotted end matching curb valve.

H. Post-Indicator: NFPA 24 and be fully compatible with the valve and supervisory switches.

2.9 DISINFECTION CHLORINE

A. Liquid chlorine: AWWA B301.

B. Sodium Hypochlorite: AWWA B300 with 5 percent to 15 percent available chlorine.

C. Calcium hypochlorite: AWWA B300 supplied in granular form of 5 g. tablets, and shall contain 65 percent chlorine by weight.

2.10 WARNING TAPE

A. Warning tape shall be standard, 4 mil. Polyethylene, 3 inch (76 mm) wide tape, detectable type, blue with black letters and imprinted with "CAUTION BURIED WATER LINE BELOW".

PART 3 - EXECUTION

3.1 DUCTILE IRON PIPE

A. Install Ductile Iron, water-service piping according to AWWA C600 and AWWA M41-3rd Edition.

B. 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. Push on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead.

3.2 PVC PIPE

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA C605. Place selected material and thoroughly compacted to one foot above the top of the pipe.
- B. Install Copper Tracer Wire, No. 14 AWG solid, single conductor, insulated. Install in the trench with piping to allow 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 per ASTM 828. Solder joints shall be wrapped with rubber tape and electrical tape. At least every 1000 feet (300 m) provide a 5 pound (2.3 kg) 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 also be attached at the end of each line.

3.3 COPPER PIPE

- A. Copper piping shall be installed in accordance with the Copper Development Association's Copper Tube Handbook and manufacturer's recommendations.
- B. Copper piping shall be bedded in 6 inches (150 mm) of sand.

3.4 VALVE INSTALLATION

- A. AWWA Valves: Install each underground valve with stem pointing up and with valve box.
- B. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- C. Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Install water service lines to a point of connection within approximately 5 feet (1500 mm) outside of building(s) to which service

is to be connected and make connections thereto. If building services have not been installed provide temporary caps and mark for future connection.

3.6 FIELD QUALITY CONTROL

- A. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. 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.
- C. Perform hydrostatic tests at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psi (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psi (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- D. Prepare reports of testing activities.

3.7 IDENTIFICATION

- A. Install continuous underground warning tape 12 inches (300 mm) directly over piping.

3.8 CLEANING

- A. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
- B. Use purging and disinfecting procedure prescribed by local utility provider or other authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - 1. Fill the water system with a water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - 2. Drain the system of the previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow system to stand for 3 hours.
 - 3. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.

4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- C. Prepare reports of purging and disinfecting activities.

--- E N D ---

SECTION 33 30 00**SANITARY SEWER UTILITIES****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This section specifies materials and procedures for construction of outside, underground sanitary sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

1.2 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 11, EARTH MOVING.
- B. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- C. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.3 ABBREVIATIONS

- A. PVC: Polyvinyl chloride plastic
- B. DI: Ductile iron pipe

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store plastic piping protected from direct sunlight and support to prevent sagging and bending. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.
- B. Handle manholes according to manufacturer's written rigging instructions.

1.5 COORDINATION

- A. Coordinate connection to sanitary sewer main with VA. (Approval from VA has been obtained indicating that the downstream sanitary systems have sufficient capacity to handle the sanitary discharge from the facility.)
- B. Contractor to obtain approval from the VA that the existing sanitary sewer systems have the capacity to handle the discharge from the facility.
- C. Coordinate exterior utility lines and connections to building lines up to 5 feet of building wall.
- D. Coordinate connection to sewer system with the COR.

1.6 QUALITY ASSURANCE:

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the VA having jurisdiction over the connection to Sewer lines and the extension, and/or modifications to Utility Systems.

1.7 SUBMITTALS:

A. Manufacturers' Literature and Data shall be submitted for the following as one package:

1. Pipe, Fittings, and, Appurtenances.
2. Jointing Material.
3. Manhole and Structure Material.
4. Frames and Covers.

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):

- A74-09.....Cast Iron Soil Pipe and Fittings
- A185/A185M-07.....Steel Welded Wire Reinforcement, Plain, for
Concrete
- A615/A615M-09b.....Deformed and Plain Carbon-Steel Bars for
Concrete Reinforcement
- A746-99.....Ductile-Iron Gravity Sewer Pipe
- C478-09.....Precast Reinforced Concrete Manhole Sections
- C857-11.....Minimum Structural Design Loading for
Underground Precast Concrete Utility Structures

C890-11.....Minimum Structural Design Loading for
Monolithic or Sectional Precast Concrete Water
and Wastewater Structures

C913-08.....Precast Concrete Water and Wastewater
Structures

C923-08.....Resilient Connectors Between Reinforced
Concrete Manhole Structures, Pipes, and
Laterals

C924-02 (2009).....Testing Concrete Pipe Sewer Lines by Low-
Pressure Air Test Method

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

C1173-10.....Flexible Transition Couplings for Underground
Piping Systems

C1440-08.....Thermoplastic Elastomeric (TPE) Gasket
Materials for Drain, Waste and Vent (DWV),
Sewer, Sanitary and Storm Plumbing Systems

C1460-08.....Shielded Transition Couplings for Use With
Dissimilar DWV Pipe and Fittings Above Ground

C1461-08.....Mechanical Couplings Using Thermoplastic
Elastomeric (TPE) Gaskets for Joining Drain,
Waste and Vent (DWV), Sewer, Sanitary and Storm
Plumbing systems for Above and below Ground Use

D2321-11.....Underground Installation of Thermoplastic Pipe
for Sewers and Other Gravity-Flow Applications

D3034-08.....Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe
and Fittings

F477-10.....Elastomeric Seals (Gaskets) for Joining Plastic
Pipe

F679-08.....Poly(Vinyl Chloride) (PVC) Large-Diameter
Plastic Gravity Sewer Pipe and Fittings

F891-10.....Coextruded Poly(vinyl Chloride) (PVC) Plastic
Pipe With a Cellular Core

F949-10.....Poly(Vinyl Chloride) (PVC) Corrugated Sewer
Pipe With a Smooth Interior and Fittings

F1417-11.....Standard Test Method for Installation
Acceptance of Plastic Gravity Sewer Lines Using
Low-Pressure Air

F1668-08.....Construction Procedures for Buried Plastic Pipe

C. American Water Works Association (AWWA):

C105/A21.5-10.....Polyethylene Encasement for Ductile-Iron Pipe
Systems

C110-08.....Ductile-Iron and Gray-Iron Fittings

C111/A21.11-06.....Rubber Gasket Joints for Ductile Iron Pressure
Pipe and Fittings

C151/A21.51-09.....Ductile Iron Pipe, Centrifugally Cast

C153/A21.53-06.....Ductile Iron Compact Fittings for Water Service

C219-11.....Bolted, Sleeve-Type Couplings for Plain-End
Pipe

C512-07.....Air Release, Air/Vacuum and Combination Air
Valves for Water Works Service

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

D. American Society of Mechanical Engineers:

A112.14.1-2003.....Backwater Valves

A112.36.2M-1991.....Cleanouts

1.9 WARRANTY

- A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year 1 from final acceptance. Further, the Contractor will provide all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS**2.1 FACTORY-ASSEMBLED PRODUCTS**

- A. Standardization of components shall be maximized to reduce spare part requirements.
- B. All pipe and fittings used in the construction of force mains shall be rated to meet the system maximum operating pressure with a minimum of 150 psi (1035 kPa).
- C. 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 PVC, GRAVITY SEWER PIPE AND FITTINGS

- A. PVC Gravity Sewer Piping:
 - 1. Pipe and Fittings shall conform to SCH 40.
 - 2. Gaskets: ASTM F477.

2.3 PVC, PRESSURE PIPE AND FITTINGS

- A. PVC:
 - 1. Pipe: AWWA C900, Class 150 PVC pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: AWWA C900, Class 150 .
 - 3. Gaskets: ASTM F477.

2.4 PVC PRESSURE (FORCE) MAIN: PVC PRESSURE (FORCE) MAIN:

- A. Joints shall be fully restrained with mechanical joints, capable of restraining 50 percent above all loads acting on the joint, but not less than 150 psi (1035 kPa). Thrust blocks shall not be permitted.
- B. Polyvinyl Chloride (PVC) Pipe and Fittings:
 - 1. Pipe: ASTM D3034, SDR 35.
 - 2. Gaskets: ASTM F477.

2.5 NONPRESSURE-TYPE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve type, reducing or transition coupling, for joining underground nonpressure piping. Include ends to match same sizes of main line piping and install corrosion-resistant metal tension bands and tightening mechanism on each end.
- B. Sleeve Materials:
 - 1. For Plastic Pipes: ASTM F477, elastomeric seal.
 - 2. For Dissimilar Pipes: PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
 - 1. Couplings shall be elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.6 CLEANOUTS

- A. PVC Cleanouts:
 - 1. PVC body with PVC threaded plug: Cleanout shall be as per ASTM D3034. PVC sewer pipe fitting and riser to cleanout.
 - 2. Cleanout Riser: Sewer pipe fitting on main line sewer and riser shall match main line piping.

2.7 PUMP AND GRINDER

- A. Grinder Pump suppliers shall be Environment/One, Barnes Pumps Inc. or an Engineer approved equal.
- B. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with mechanical seal. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. The material shall be suited for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, good aging properties, and outstanding wear resistance.
- C. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece stainless steel motor shaft. The grinder impeller assembly shall be securely fastened to the pump motor shaft. The grinder will be of the rotating type with a stationary hardened and ground chrome steel shredding ring spaced in accurate close annular alignment with the driven impeller assembly,

which shall carry two hardened type 400 series stainless steel cutter bars. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to eliminate clogging and jamming under all normal operating conditions including starting. Sufficient action shall be created to scour tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:

1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.
 2. The inlet shroud shall have a diameter no less than 5 inches.
 3. At maximum flow the average inlet velocity must not exceed 0.2 feet per second.
 4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.
- D. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects", such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter s/s discharge piping.

2.8 ELECTRIC MOTOR

- A. As a minimum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, squirrel cage induction type with a low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector combination shall have been specifically investigated and listed by Underwriters Laboratories Inc., for the application.

2.9 MECHANICAL SEAL

- A. The core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

2.10 TANK AND INTEGRAL ACCESS WAY

- A. The tank and integral access way shall be as specified below:

1. Environmental/One (Duplex) WH101
2. Barnes (Duplex) Duplex Package With Ultra Switch
 - a. Barnes hatch shall be a lockable hinged access door with stainless steel hinges and hardware.

2.11 CONTROLS AND ELECTRICAL SERVICE PIPING AND FITTINGS

- A. Each grinder pump station control panel shall be Nationally Recognized Testing Laboratory (NRTL) certified to U.L. 508. Each panel shall have a NEMA 4X enclosure. It shall include circuit breakers and all necessary components to accomplish proper pump operation. Each control panel shall include a visual and audible, with silence button, alarm device. The visual alarm shall be a red fluted lens mounted to the top of the enclosure in such a manner as to maintain rain proof integrity. The audio device shall be capable of being de-activated by means of a silence switch mounted on the exterior of the enclosure.
- B. DUPLEX STATIONS - Duplex stations shall have their own separate electrical service which shall be directionally bored to the station if the forcemain pipe is directionally bored to the station. Control panel shall be located on a 6"x6" treated post located near the station. The Contractor shall include all work necessary for a complete operable station. Provide three (3) run time meters.

2.12 SPARE UNITS

- A. The Manufacturer will supply one (1) spare grinder pump core , all operation controls level sensors, check valve, anti-siphon valve, pump/motor unit, and grinder

2.13 MANHOLES

- A. Standard precast concrete manholes and vaults shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections or cast-in-place concrete.
 1. Precast Concrete Manholes: Material shall be as per ASTM C478, precast, reinforced concrete, of depth indicated, with sealed joints.
 2. Concrete Base: Concrete for base of manhole shall have a minimum compressive strength of 5000 psi (35 MPa) at 28 days. Thickness to be 8 inches (200 mm), minimum.
 3. Riser Section: 4 inch (100 mm) minimum thickness, of lengths to provide the total depth of manhole.

4. Top Section: Eccentric-cone type unless otherwise indicated. Top section to match adjustment ring configurations.
5. Joint Sealant: ASTM C990.
6. Resilient Pipe Connectors: ASTM C923.
7. Steps: If over 60 inches (1500 mm) in depth, individual FRP steps or ladder ASTM A615 deformed, 1/2 inch (13 mm) steel reinforcing rods encased in precast concrete sections with 16 inch (400 mm) minimum width, 12 to 16 inches (300 to 400 mm) center-to-center from top to bottom.
8. Adjusting Rings: Reinforced-concrete rings; 6 to 9 inch (150 to 225 mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

2.14 CONCRETE

- A. Cast-in-place concrete shall be 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.
- B. Reinforcement
 1. Reinforcing fabric shall be ASTM A185, steel, welded wire fabric, plain.
 2. Reinforcing bars shall be ASTM A615, Grade 60 (420 MPa) deformed steel.
- C. Benches shall be concrete, sloped to drain into the channel. Provide 6 inches (150 mm) from the cut section of top of pipe to edge of manhole.
- D. Ballast and Pipe Supports shall be Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.

2.15 WARNING TAPE

- A. Warning tape shall be standard, 4 mil (0.1 mm) polyethylene 3 inch (76 mm) wide tape detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans and details indicate the general location and arrangement of underground sanitary sewer piping. Install piping as indicated, to

extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

- B. Install piping beginning at the low point, true to grades and alignment indicated on the drawings, 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 using lubricants, cements, and other installation requirements.
- C. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- D. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- E. 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.
- 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 walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 12 inches (300 mm) over the crown of the pipe.
- H. Warning tape shall be continuously placed 12 inches (300 mm) above sewer pipe
- I. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- J. 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.
- K. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process or microtunneling.
- L. Install gravity-flow, non-pressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
 - 2. Install piping with Insert 8.0' minimum cover as shown on Drawings.
 - 3. Install ductile iron, gravity sewer piping according to AWWA C600.

4. Install PVC cellular-core, PVC corrugated sewer, PSM sewer and PVC gravity sewer according to ASTM D2321 and ASTM F1668.
- M. Install force-main, pressure piping according to the following:
1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fittings, or cast-in-place-concrete supports or anchors. Pressure (force) mains shall have the bells facing the direction of flow.
 2. Sections of piping listed on the drawings shall be fully restrained. For devices with twist off nuts, the twist off nuts shall be placed on top of the fitting for the Resident Engineer's inspection. The Contractor shall torque test all bolts, set screws, identified by the Resident Engineer.
 3. Thrust blocks shall not be permitted.
- N. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.2 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, non-pressure, drainage piping according to the following:
1. Join ductile iron, gravity sewer piping according to AWWA C600 for push-on joints.
 2. Join PVC piping according to ASTM D2321.
 3. Join dissimilar pipe materials with nonpressure-type, flexible couplings.
- B. Join force-main, pressure piping according to the following:
1. Join ductile iron pressure piping according to AWWA C600 for push-on joints.
 2. Join PVC pressure piping according to manufacturer's recommendations.
 3. Join dissimilar pipe materials with pressure-type couplings.
- C. 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 non-pressure flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.
 - a. Unshielded couplings for pipes of same or slightly different OD.

- 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 pipe couplings for force-main joints.

3.3 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES WITHIN VAULTS

- A. Install reinforced concrete as detailed on the drawings. The concrete shall not restrict access for future maintenance of the joints within the piping system.

3.4 BUILDING SERVICE LINES

- A. Install sanitary sewer service lines to point of connection within approximately 5 feet (1500 mm) outside of building(s) where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.

3.5 MANHOLE INSTALLATION

- A. Install manholes complete with appurtenances and accessories indicated.
 - 1. 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 1/2 inch (15 mm) or cement mortar applied with a trowel and finished to an even glazed surface.
 - 2. 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 as per manufacturer's recommendations. Adjust the length of the rings so that the top section will be at the required elevation. Cutting the top section is not acceptable.
 - 3. Concrete manhole risers and tops: Install as specified.
- B. Designed Concrete Structures:
 - 1. Concrete structures shall be installed in accordance with Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Do not build structures when air temperature is 32 deg F (0 deg C), or below.
- D. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.

- E. 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.
- F. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. In unpaved areas, the rim elevation shall be 2 inches (50 mm) above the adjacent finish grade.
- G. Install manhole frames and covers on a mortar bed, such that 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. Install an 8 inches (200 mm) thick, by 12 inches (300 mm) wide concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Cleanouts should be 6 inches (150 mm) in diameter and consist 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. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete, 18 by 18 by 12 inches (450 by 450 by 300 mm) 1 inch (25 mm) above surrounding grade.
- C. Where cleanout is in force main, provide a blind flange top connection. The center of the flange shall be equipped with a 2 inches (50 mm) 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 24 inches (600 mm) in diameter.
- D. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

- E. The top of the cleanout assembly shall be 2 inches (50 mm) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.7 EXCAVATION, TRENCHING & BEDDING

- A. Excavate for manhole in accordance with Section 31 20 11 - Earthwork for the work of this section.
- B. Ballast requirements shall be determined by the Contractor and the Manufacturer.
- C. Any concrete ballast, rock ballast or manufacturer required installation items shall be completed per the manufacturer's recommendations or installation instructions.

3.8 GRAVITY SEWER STUBS FROM GRINDER STATION

- A. The Contractor shall core drill and grommet the gravity connections to the residential grinder stations in the field to ensure proper alignment and grade for residential connections.
- B. The Contractor shall install a PVC sanitary sewer service pipe of the size and material shown on the plans for each lot served by the residential grinder station.
- C. The Contractor shall install a cleanout at the end of each gravity sewer stub.

3.9 FIELD QUALITY CONTROL

- A. Field inspecting and testing.
- B. Any portion of the work deemed to be defective through the testing and start-up shall be remedied at no additional cost to the Owner.
- C. Contractor and COR shall be present for all testing and start-up for verification of results.
- D. The Owner will not consider final acceptance or substantial completion until all testing, cleaning, start-up and corrective action is completed to the satisfaction of the COR.

3.10 CONNECTIONS

- A. Make connections to existing piping and underground manholes by coring and installing the pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.

- B. Connection to an existing manhole: The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all new pipes connected to the manhole.
- C. Use commercially manufactured wye fittings for piping branch connections. Encase entire wye 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).
 - 1. Make branch connections from the side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500), by removing a section of the existing pipe.
 - 2. Make branch connections from the side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting an opening into existing unit 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 or manhole wall, encase entering connection in concrete to provide additional support of collar from connection to undisturbed ground.
 - 3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.11 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.

3.12 PIPE SEPARATION

- A. Horizontal Separation - Water Mains and Sewers:

1. Existing and proposed water mains shall be at least 10 feet (3 m) 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 10 feet (3 m) but not closer than 6 feet (1.8 m) to a water main when:
 - a. Local conditions prevent a lateral separation of 10 feet (3 m); and
 - b. The water main invert is at least 18 inches (450 mm) above the crown of the gravity sewer or 24 inches (600 mm) above the crown of the pressure (force) main; and 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.

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 24 inches (600 mm) above the crown of gravity flow sewer or 48 inches (1200 mm) above the crown of pressure (force) mains. The vertical separation shall be maintained within 10 feet (3 m) 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 24 inches (600 mm) of water lines.
3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 18 inches (450 mm) above or 12 inches (300 mm) 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 24 inches (600 mm) below the water line provided both the water line and sewer line are constructed of ductile iron pipe.
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 10 feet (3 m).

3.13 IDENTIFICATION

- A. Install green warning tape directly over piping and at outside edges of underground manholes.

3.14 FIELD QUALITY CONTROL

- A. All systems shall be inspected and obtain the Resident Engineer's approval. 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.
- B. To inspect, thoroughly flush out the lines and manholes before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lips at joints on the inside of gravity sewer lines are not acceptable.
 - 1. Submit separate report 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. Re-inspect and repeat procedure until results are satisfactory.
- C. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - 1. Test plastic gravity sewer piping according to ASTM F1417.
 - 2. Test concrete gravity sewer piping according to ASTM C924.
 - 3. 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 4 psi (28 kPa) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 3.5 psi (24 kPa) greater than the average back-pressure of any groundwater above the sewer.

4. For force mains, perform testing after supports and anchors are installed. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psi (1035 kPa).
5. Testing of Fiberglass Sewage Holding Tanks shall show no leakage during a 5 psi (35 kPa) air pressure test with 5:1 safety factor.
6. Testing of Concrete Wet Well shall show no leakage with the wet well completely filled with water for a duration of 4 hours.

3.15 CLEANING

- A. Clean dirt and superfluous material from interior of piping.

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