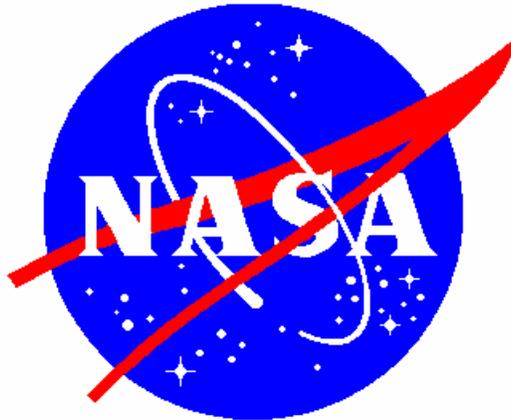


Attachment A

**SPECIFICATIONS FOR
REPAIR OF WATER SYSTEM – PHASE 2**



**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GLENN RESEARCH CENTER
21000 BROOKPARK ROAD, CLEVELAND, OHIO 44135**

9410

May 22, 2008

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SECTION 01104

CONTAMINATED SOIL STORAGE, TRANSPORTATION, AND DISPOSAL

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES

The publications listed below form a part of this section to the extent referenced:

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	(2001) Occupational Safety and Health Standards
40 CFR 261	(1993) Identification and Listing of Hazardous Waste
40 CFR 262	(1993) Standards Applicable to Generators of Hazardous Waste
49 CFR 171	(1993) General Information, Regulations and Definitions
49 CFR 172	(1993) Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 178	(1993) Shipping Containers Specifications
GLN-QSE-8500.1A	Glenn Environmental Programs Manual

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Statements shall be submitted for the following items in accordance with paragraphs entitled, "Site Specific Health and Safety Plan" and "Site Specific Work Plan," of this section.

Site Specific Health and Safety Plan G
Site Specific Work Plan G

1.3.1 Site Specific Health and Safety Plan

For companies performing contaminated waste soil operations, a Detailed Description of the work to be performed shall be submitted. The plan shall include but not be limited to objectives, methods, resources and personnel required to complete the task and shall evaluate the potential hazards of the chemical contaminants and explain how workers shall be protected from those hazards. Personnel performing solid and hazardous waste activities shall be trained pursuant to 29 CFR 1910, Hazardous Waste Operations and Emergency Response (HAZWOPER) and 49 CFR 172, Transportation of Hazardous Materials. For all workers and supervisors performing solid and hazardous waste activities, include 40-hour HAZWOPER training certificates. Employees handling hazardous materials shall be trained in compliance with 49 CFR 172, and the Work Plan shall include evidence of such training. For companies performing hazardous waste operations, a copy of the Contractor's Hazard Communication Program shall be attached to the Site Specific Health and Safety Plan as an Appendix. The Program shall address the evaluation of the potential hazards of chemicals in the work place, communicating information concerning these hazards to employees and descriptions of appropriate measures. Six (6) copies of the Site Specific Health and Safety Plan (including the Hazard Communication Program if required) shall be submitted at least three (3) weeks prior to beginning excavation activities.

1.3.2 Site Specific Work Plan

For contaminated waste soil operations, a Detailed Description of the work to be performed shall be submitted. The work plan shall include but not be limited to objectives, methods, resources and personnel required to complete the task including plans for the decontamination of equipment and personnel. The following shall be included:

1. Licenses/Permits - Provide the name and licenses for the waste hauler and the disposal facility.
2. Container Sizes and Suppliers - Provide sizes and suppliers of drums, roll-offs, dump trailers, dump trucks, tanker trucks and frac tank.
3. Profiles - Provide completed Waste Profile Sheets, Waste Product Questionnaires, or Waste Characterization Reports describing the type of solid or hazardous waste generated, volume, frequency, generator name and address, broker and certification statement. Land Disposal Restriction Notification forms shall be included if applicable. Analytical data, to be provided by NASA, shall accompany the Waste Profile. The COTR will obtain the required NASA signatures on the Waste Profiles.
4. Draft Manifests - Provide completed DRAFT Hazardous Waste and Solid Waste Manifests describing the waste being disposed of in accordance with 40 CFR 261.
5. A description of how stormwater and surface runoff will be prevented from entering the excavation shall also be included.
6. If Hazardous Waste soils are to be excavated, a description of the Hazardous Waste Zones Implementation shall be included (see paragraph 3.3 of this specification section).

Six (6) copies of the Site Specific Work Plan shall be submitted at least

three (3) weeks prior to beginning excavation activities.

1.4 NOTIFICATIONS

1.4.1 Landfill Approval Letter

Letters, forms, or other written documents supplied to the Contractor from the facility designated for the disposal of hazardous or solid waste acknowledging the wastes are acceptable for disposal. All approvals shall be on company letterhead and bear the signature of an authorized representative of the disposal facility. Provide approval letters at least one week (1) prior to beginning excavation activities. No excavation activities shall be permitted prior to NASA's receipt and acknowledgement of the landfill approval letter.

1.4.2 Disposal Records

Provide Disposal Tickets, Weigh Tickets or other records supplied by the disposal facility documenting the weight of waste material disposed of at the disposal facility.

Provide disposal records to NASA within one (1) week of receipt by the Contractor.

1.4.3 Final Manifests

Provide Final, Signed Hazardous Waste and Solid Waste Manifests completed by the Contractor and the disposal facility in accordance with 40 CFR 261. Robert F. Lallier, Environmental Manager (address: GRC-Plum Brook Station, 6100 Columbus Avenue, Sandusky, Ohio 44870) shall receive the final signed Manifest directly from the disposal facility. In the event that the Contractor receives the Final signed manifests, it shall be immediately forwarded to Mr. Lallier.

1.5 QUALITY ASSURANCE

No contaminated soil shall be removed from the site without written authorization from the Government in the form of completed and signed Waste Manifests and Property Passes.

The COTR will obtain the required NASA signature on all waste profiles, (Land Disposal Restriction Forms, if applicable), property passes and manifests for contaminated waste soil shipments.

The COTR may perform inspections of containers intended for the storage or transportation of soils at any time, and will perform weekly inspections of all containers storing contaminated waste soils.

PART 2 PRODUCTS (Not Applicable)

2.1 DRUMS

Metal and fiberglass drums shall comply with 49 CFR 178.

Drums shall be marked with the manufacturer's certification, specification, approval, or exemption mark.

Reconditioned drums shall be free of old labels and markings.

Containers shall be of a suitable size and constructed of material which is compatible with the waste being placed in them. Containers shall be leak proof, sift proof and lined with 10 mil (minimum) plastic liner to prevent materials from coming into contact with the inner surface of the container.

Drums shall be identified with number provided by the COTR.

2.2 ROLL-OFFS

Containers shall be leak proof, sift proof and lined with 10 mil (minimum) plastic liner to prevent materials from coming into contact with the inner surface of the container.

Containers shall be constructed of materials which are compatible with the waste being placed in them.

Containers shall be covered with leak proof tarpaulin and secured at all times except when being loaded so that no foreign materials, debris, or rainwater enters the container.

Rolloff boxes shall be identified with number provided by the COTR.

2.3 DUMP TRAILERS AND SUMP TRUCKS

Containers shall be leak proof, sift proof and lined with 10 mil (minimum) plastic liner to prevent materials from coming into contact with the inner liner surface of the container.

Containers shall be covered with a tarpaulin and secured at all times except when loaded so that no foreign materials, debris, or rainwater enters the container.

2.4 TANKER TRUCKS

Inner and outer valves shall be in working condition with visible means of secure closure to prevent leakage.

2.5 FRAC TANKS

Inner and outer valves shall be in working condition with visible means of secure closure to prevent leakage.

Holding tanks used for the temporary storage shall be made of material which are compatible with the liquid waste.

2.6 CONTAINERS

All containers used for storage and transportation of hazardous waste soils shall meet the requirements of 49 CFR 178. Containers and liners shall also meet the requirements of the disposal facility. Containers used for the transportation of hazardous waste soils shall be labeled in accordance with 49 CFR 171 and 49 CFR 172.

PART 3 EXECUTION

3.1 STORAGE AND TRANSPORTATION

The Contractor shall obtain approval from the COTR for the location of any temporary stored soils and containers.

Excavated solid waste soil shall be placed directly into containers or trucks to prohibit infusion of rainwater or foreign debris. Excavated solid waste soils shall not be permitted to be stockpiled.

Excavated hazardous waste soil shall be placed directly into a container or truck and covered to prohibit infusion of rainwater or foreign debris. Excavated hazardous waste soils shall not be permitted to be stockpiled.

All containers shall be properly labeled and marked prior to filling. If the soil is non-hazardous solid waste, the standard green non-hazardous waste label shall be used. If the soil is hazardous waste, the standard red and white Environmental Protection Agency (EPA)/ Department of Transportation (DOT) label shall be used until shipped. At the time of shipping, the yellow and red hazardous waste label shall be placed over the red and white label and completely filled out. Labels shall include, at a minimum, the date of generation, the project title, the Contractor's name and phone number, and the COTR's name and phone number.

Storage of any hazardous waste soil shall not exceed 90 days from the date of generation in accordance with 40 CFR 262.

Vehicles transporting waste soils for disposal shall be weighed on NASA scales located at Building 9209. Vehicles shall be weighed by the Government prior to and after loading of excavated materials. The resulting weight of the waste shall be recorded on the Waste Manifests.

Vehicles transporting waste soils for disposal shall not leave NASA without a completed and signed Property Pass, and completed, numbered and signed Waste Manifest. This paperwork is required for each load leaving GRC. The Contractor shall not sign any Waste Manifests. The COTR shall obtain manifest numbers from Robert F. Lallier, Environmental Manager, or his designee, several days in advance of shipment. Only Robert Lallier, or his designee, may sign hazardous waste manifests. The top white copy of the Property Pass with the actual signature shall be surrendered to the Security Guards at the Main Gate when exiting GRC - Plum Brook Station.

3.2 DISPOSAL

All soil designated as a solid waste shall be disposed of at an OEPA licensed solid waste facility. The Contractor shall comply with the requirements of the disposal facility.

All soil designated as a hazardous waste shall be disposed of at a state permitted hazardous waste facility. The Contractor shall comply with the requirements of the disposal facility.

3.3 HAZARDOUS WASTE OPERATIONS

To reduce the spread of hazardous waste soil from contaminated areas, the Contractor shall delineate zones on the site where different types of operations will occur. The flow of personnel among these zones shall be controlled. This information shall be provided in the Work Plan.

The site shall be divided into at least 3 zones.

1. Exclusion Zone - This is the area where most of the work is accomplished and contamination is present. The outer boundary shall be identified as the Hotline. The Hotline shall be marked by hazard tape,

signs, barricades and fences. Flow of personnel and equipment shall be controlled.

2. Containment Reduction Zone - This is the transition area between the contamination area and the clean area. Decontamination of personnel and equipment shall take place in this area. The outer boundary shall be identified as Contamination Control Line.
3. Support Zone - This is the outermost area. No contamination of any kind shall exist in this area. Administrative and support functions shall be performed in this area.

3.4 STORM AND SURFACE WATER

The Contractor shall prevent Storm Water runoff from entering any open Solid Waste or Hazardous Waste excavation. The Contractor shall notify the COTR of the presence of Storm Water in excavations. Any Storm Water that accumulates in such an excavation shall be considered as a solid waste or a hazardous waste liquid and shall be containerized by the Contractor for analysis. The Contractor shall obtain sampling and analysis of the liquid in accordance with the Ohio Environmental Protection Agency (EPA) Pre-Treatment Standards. The Contractor shall coordinate the sampling and analytical through the COTR. Once the data is available, NASA will coordinate with the COTR, and shall be in accordance with this Section. If the Ohio EPA determines that the liquid meets the Pre-Treatment Standards, NASA will direct the Contractor on the appropriate method of discharge to the Sanitary Sewer System. The COTR shall discuss analytical results with the PBS Environmental Manager who will provide guidance on acceptable disposal. With either determination, the Contractor shall be responsible for all costs associated with the sampling, analysis, containerizing, transportation and disposal of the Storm Water Runoff.

3.5 GROUNDWATER

The Contractor shall notify the COTR of the presence of groundwater in excavations. Any groundwater that accumulates in such an excavation shall be considered as a solid waste or a hazardous waste liquid and shall be containerized for analysis. NASA shall obtain sampling and analysis of the liquid in accordance with the Ohio Environmental Protection Agency (EPA) Pre-Treatment Standards and shall coordinate the sampling and analytical. Once the data is available, NASA will coordinate with the NEOSRD and determine the disposition of the water. If the Ohio EPA determines that a liquid does not meet the Pre-Treatment Standards, all subsequent transportation and disposal shall be coordinated with the COTR, and shall be in accordance with this Section. If the Ohio EPA determines that the liquid meets the Pre-Treatment Standards, NASA will direct the Contractor on the appropriate method of discharge to the Sanitary Sewer System. With either determination, NASA shall be responsible for all costs associated with the sampling, analysis, containerizing, transportation and disposal of the groundwater.

3.6 DIFFERING SITE CONDITIONS

There is the possibility that the Contractor, in the execution of the Work, may encounter a pre-existing soil or groundwater contamination, of which NASA is unaware. If a condition occurs where contamination appears that is different than the contamination expected, the Contractor shall stop work within the immediate area of the impact and notify the COTR. The Contractor shall isolate the impacted area of the differing site condition

to the smallest possible footprint, and may continue work in areas outside of the impacted area.

-- End of Section --

SECTION 01110

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

The work to be performed under this contract consists of providing the labor, equipment, and materials to repair and improve the water systems at Plum Brook Station in Sandusky, Ohio. This work will be completed in compliance with all Ohio EPA regulations. This project will consist of a base bid package and four (4) options as discribed below.

Base Bid:

- Install approximately 16,326 linear feet of 12" HDPE water line and valves as shown on drawings.
- Add tie into the Erie County Water System on Mason Road.
- Install 1 metering station at tie in location to Erie County.
- Install 1 metering station and a new tie into the the Space Power Faciility at Plum Brook Station.

Option 1:

- Install approximately 5,122 linear feet of 8" HDPE water line and valves along Maintenance Road as shown on drawings.

Option 2:

- Install approximately 1,228 linear feet of 12" HDPE water line and valves along Maintenance Road as shown on drawings.

Option 3:

- Install approximately 5,736 linear feet of 6" HDPE water line and valves along as shown on drawings.

Option 4:

- Install approximately 1,563 linear feet of 8" HDPE water line and valves along Maintence Road as shown on drawings.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Submit the following items to the Contracting Officer:

- Utility Outages
- Connection Requests
- Borrow Permits
- Excavation Permits
- Welding Permits
- Burning Permits

1.4 CONTRACT DRAWINGS

The following drawings accompany this specification and are a part thereof.

G-001 Title Sheet
 G-002 Sheet Index Map and Miscellaneous Details
 G-003 General Notes
 C-101 N. Columbus Ave. and N. Magazine Rd., Sta. 41+44 to Sta. 62+27
 C-102 Line Rd. 12, Sta. 62+27 to Sta. 93+37
 C-103 Line Rd. 12, Sta. 93+37 to Sta. 125+39
 C-104 Line Rd. 12 to Space Power Facility, Sta. 125+39 to Sta. 140+04
 C-105 S. Columbus Ave., Sta. 140+04 to Sta. 166+80
 C-106 S. Columbus Ave., Sta. 166+80 to Sta. 198+84
 C-107 S. Columbus Ave., Sta. 198+84 to Sta. 204+70
 C-108 Maintenance Rd., Sta. 10+00 to Sta. 41+47
 C-109 Maintenance Rd., Sta. 41+47 to Sta. 61+22
 C-110 N. Magazine Rd., Sta. 10+00 to Sta. 38+16
 C-111 N. Magazine Rd. to Box Factory Rd., Sta. 38+16 to Sta. 52+75
 C-112 Fox Rd. to Box Factory Rd., Sta. 10+00 to Sta. 24+61
 C-113 Taylor Rd., Sta. 10+00 to Sta. 25+63
 C-501 Miscellaneous Details
 C-502 Miscellaneous Details
 C-503 Storm Water Pollution Prevention Details
 C-504 Storm Water Pollution Prevention Details
 E-101 Mason Rd. Metering Chamber
 E-102 Space Power Facility Metering Chamber
 E-501 Electrical Detail and Site Map

Drawings are available for purchase from Northeast Blueprint:

Address: 1230 East 286 Street
 Cleveland, OH 44132
 Phone Number: (216)261-7500
 Fax Number: (216)261-7650
 Email address: neblue@aol.com

Contractor shall immediately check furnished drawings and notify the Government of any discrepancies.

1.5 WORK RESCHEDULING

Contractor shall allow for a maximum of 15 days where construction activity is prohibitive. Government will provide 24 hour notification each time the restrictions are invoked.

Normal duty hours for work shall be from 7:30 a.m. to 4:00 p.m., Monday through Friday. Requests for additional work shall require written approval from the Contracting Officer 3 days in advance of the proposed work period.

1.6 ON-SITE PERMITS

1.6.1 Utility Outages and Connection Requests

Work shall be scheduled to hold outages to a minimum.

Utility outages and connections required during the prosecution of work that affect existing systems shall be arranged for at the convenience of the Government and shall be scheduled outside the regular working hours or on weekends.

Requests for utility outages and connections shall be made in writing to the Contracting Officer at least 5 working days in advance of the time required. Each request shall state the system involved, area involved, approximate duration of outage, and the nature of the work involved.

1.6.2 Borrow, Excavation, Welding and Burning Permits

<u>ACTIVITY</u>	<u>SUBMISSION DATE</u>	<u>SUBMISSION FORM</u>
Soil Relocation Permits	7 days prior to work	C-9436
Burning Permits	7 days prior to work	C-7A, C-7B
Welding Permits	7 days prior to work	C-7A, C-7B
Digging & Excav. Permits	7 days prior to work	GLF-H-1740.1
Confined Space Entry Permit	7 days prior to work	C-199

Permits shall be posted at a conspicuous location in the construction area.

Burning of trash or rubbish is not permitted.

1.7 SALVAGE MATERIAL AND EQUIPMENT

Items of material designated by the Contracting Officer to be salvage shall remain the property of the Government.

It shall be segregated, itemized, delivered, and off-loaded at the Government designated storage area located within Plum Brook Station.

Contractor shall maintain property control records for material or equipment designated as salvage. Contractor's system of property control may be used if approved by the Contracting Officer. Contractor shall be responsible for storage and protection of salvaged materials and equipment until disposition by the Contracting Officer.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01315

PROJECT MEETINGS

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

A Project Submittal Schedule shall be submitted in accordance with paragraph entitled, "Project Meetings," of this section.

The Contractor shall submit a Monthly Progress Report at the first meeting of each month.

1.4 PRECONSTRUCTION CONFERENCE

The Contractor shall attend a preconstruction conference scheduled by the Contracting Officer. Work shall not commence prior to the conference.

Discussion shall address project orientation, personnel contact, safety issues, permits, deficiencies, and the location of the Contractor's office.

1.5 PROJECT MEETINGS

The Contractor shall attend weekly project meetings scheduled by the Government.

A Monthly Progress Report shall be submitted which addresses the progress schedule, potential factors of delay, deficiencies, material delivery schedules, submittals, and safety issues.

A Project Submittal Schedule shall be submitted showing full coordination with the project schedule. All products and tests under each submittal number shall be prioritized and linked to the progress schedule.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

A standard transmittal form provided by the Government shall be used to transmit each submittal.

Submittal Description (SD): Drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials to be furnished by the Contractor explaining in detail specific portions of the work required by the contract.

The following items, SD-01 through SD-11, are descriptions of data to be submitted for the project. The requirements to actually furnish the applicable items will be called out in each specification.

SD-01 Preconstruction Submittals

Submittals which are required prior to a notice to proceed on a new contract. Submittals required prior to the start of the next major phase of the construction on a multi-phase contract. Schedules or tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work, submitted prior to contract notice to proceed or next major phase of construction.

SD-02 Shop Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work.

SD-03 Product Data

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents.

SD-05 Design Data

Design calculations, mix design analyses, or other data, written in nature, and pertaining to a part of the work.

SD-06 Test Reports

Written reports of a manufacturer's findings of his product during field inspections, attesting that the products are installed in accordance with the manufacturer's installation instructions, shop drawings, or other manufacturer's requirements. Written reports by a general contractor or his subcontractors including daily logs reporting on the progress of daily activities or attesting that the work has been installed in accordance with the contract plans and specifications.

SD-07 Certificates

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other Lower Tier Contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality.

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system, or material, including special notices and material safety data sheets, if any concerning impedances, hazards, and safety precautions.

SD-09 Manufacturer's Field Reports

A written report which includes the findings of a test made at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation. Report must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

SD-10 Operation and Maintenance Data

Data intended to be incorporated in an operations and maintenance manual.

SD-11 Closeout Submittals

Special requirements necessary to properly close out a construction contract. For example, as-built drawings, manufacturer's help and product lines necessary to maintain and install equipment. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.4 PREPARATION

1.4.1 Marking

Permanent marking shall be provided on each submittal to identify it by contract number; transmittal date; Contractor's, Subcontractor's, and supplier's name, address(es) and telephone number(s); submittal name; specification or drawing reference; and similar information to distinguish

it from other submittals. Submittal identification shall include space to receive the review action by the Contracting Officer.

1.4.2 Drawing Format

Drawing submittals shall be prepared on translucent, reproducible sheets, not less than 8-1/2 by 11 inches nor larger than 30 by 42 inches in size, except for full size patterns or templates. Drawings shall be prepared to accurate size, with scale indicated, unless other form is required. Drawing reproducibles shall be suitable for microfilming and reproduction on the Diazo or Ozalid machines and shall be of a quality to produce clear, distinct lines and letters. Drawings shall have dark lines on a white background.

Copies of each drawing shall have the following information clearly marked thereon:

- a. Job name, which shall be the general title of the contract drawings.
- b. Date of the drawings and revisions.
- c. Name of Contractor.
- d. Name of Subcontractor.
- e. Name of the item, material, or equipment detailed thereon.
- f. Number of the submittal (e.g., first submittal, etc.) in a uniform location adjacent to the title block.
- g. Government contract number shall appear in the margin, immediately below the title block.

Drawings shall be numbered in logical sequence. Contractor may use his own number system. Each drawing shall bear the number of the submittal in a uniform location adjacent to the title block. Government contract number shall appear in the margin, immediately below the title block, for each drawing.

A blank space, no smaller than 2" x 3" shall be reserved on the right hand side of each sheet for the Government disposition stamp.

1.4.3 Data Format

Required data submittals for each specific material, product, unit of work, or system shall be collected into a single submittal and marked for choices, options, and portions applicable to the submittal. Marking of each copy of product data submitted shall be identical. Partial submittals will be accepted for expedition of construction effort.

1.5 SUBMISSION REQUIREMENTS

1.5.1 Schedules

At the Preconstruction conference, the Contractor shall provide, for approval by the Contracting Officer, the following schedule of submittals:

- a. A schedule of shop drawings and technical submittals required by

the specifications and drawings. Schedule shall indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.

- b. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).
- c. Submittals called for by the contract documents will be listed on one of the above schedules. If a submittal is called for but does not pertain to the contract work, the Contractor shall include it in the applicable schedule and annotate it "N/A" with a brief explanation. Approval of the schedules by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the schedules or marked "N/A".
- d. Copies of both schedules shall be re-submitted monthly annotated by the Contractor with actual submission and approval dates. When all items on a schedule have been fully approved, no further re-submittal of the schedule is required.

1.5.2 Drawings Submittals

One translucent reproducible copy and six blackline or blue-line opaque prints of each drawing shall be submitted. Two prints, marked with review notations by the Contracting Officer, will be returned to the Contractor.

1.5.3 Data Submittals

Six complete sets of indexed and bound product data shall be submitted. One set, marked with review notations by the Contracting Officer, will be returned to the Contractor.

1.6 GOVERNMENT'S REVIEW

1.6.1 Review Notations

Contracting Officer will review submittals and provide pertinent notation within 21 calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

- a. Submittals marked "approved" authorize the Contractor to proceed with the work covered.
- b. Submittals marked "approved as noted" authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections. Notes shall be incorporated prior to submission of the final submittal.
- c. Submittals marked "return for correction" require the Contractor to make the necessary corrections and revisions and to re-submit them for approval in the same routine as before, prior to

proceeding with any of the work depicted by the submittal.

- d. Submittals marked "not approved" or "disapproved" indicate noncompliance with the contract requirements and shall be re-submitted with appropriate changes. No item of requiring a submittal shall be accomplished until the submittals are approved or approved as noted.
- e. Contractor shall make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes" shall be given to the Contracting Officer. Approval of the submittals by the Contracting Officer shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Contractor shall be responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.
- f. If changes are necessary to approved submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change shall be accomplished until the changed submittals are approved.

1.7 PROGRESS SCHEDULE

1.7.1 Bar Chart

Contractor shall:

- a. Submit the progress chart, for approval by the Contracting Officer, at the Preconstruction Conference in one reproducible and 4 copies.
- b. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.
- c. Include no less than the following information on the progress chart:
 - (1) Break out by major headings for primary work activity.
 - (2) A line item break out under each major heading sufficient to track the progress of the work.
 - (3) A line item showing contract finalization task which includes punch list, clean-up and demolition, and final construction drawings.
 - (4) A materials bar and a separate labor bar for each line item. Both bars will show the scheduled percentage complete for any given date within the contract performance period. Labor bar will also show the number of men (man-load) expected to be working on any given date within the contract performance period.

- (5) The estimated cost and percentage weight of total contract cost for each materials and labor bar on the chart.
- (6) Separate line items for mobilization and drawing submittal and approval. (These items are to show no associated costs.)
- d. Update the progress schedule in one reproduction and 4 copies every 30 days throughout the contract performance period.

1.8 STATUS REPORT ON MATERIALS ORDERS

Within 21 days after notice to proceed, the Contractor shall submit, for approval by the Contracting Officer, an initial status report on materials orders. This report will be updated and re-submitted every 7 days as the status on material orders changes.

Report shall list, in chronological order by need date, materials orders necessary for completion of the contract. The following information will be required for each material order listed:

- a. Material name, supplier, and invoice number.
- b. Bar chart line item or CPM activity number affected by the order.
- c. Delivery date needed to allow directly and indirectly related work to be completed within the contract performance period.
- d. Current delivery date agreed on by supplier.
- e. When item d exceeds item c, the effect that delayed delivery date will have on contract completion date.
- f. When item d exceeds item c, a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01411

GENERAL SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES

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

CODE OF FEDERAL REGULATIONS (CFR)

10 CFR 20	(1991) Standards for Protection Against Radiation
29 CFR 1910	(1996) Occupational Safety and Health Standards
29 CFR 1926	(1996) Safety and Health Regulations for Construction

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Records shall be submitted in accordance with paragraph entitled, "Gas Protection," of this section.

SD-07 Certificates

Statements shall be submitted for the following items in accordance with paragraphs entitled, "Safety Plan" and "Protection Plan," of this section.

Site Specific Health and Safety Plan G
Protection Plan G

License Certificates for radiation materials and equipment shall be submitted by the Contracting Officer prior to the start of work.

1.3.1 Site Specific Health and Safety Plan

Contractor shall submit a site specific health and safety plan to the Contracting Officer for approval within 10 working days after award of contract and it must be approved prior to notice to proceed. Compliance to the safety plan is mandatory. A copy of this approved plan shall be

maintained in the Contractor's field office. This document will be made available upon request from the Contracting Officer's Technical Representative and the Safety Office.

The Site Specific Health and Safety plan shall include, as a minimum, the following:

- a. Safety program objectives.
- b. Methods to attain safety objectives.
- c. Responsibility of key personnel for the Contractor.
- d. Safety meetings, surveys, inspections, and reports.
- e. Identification of unusual safety hazards and mitigation plan to allow for safe conduct of work.
- f. Disaster and emergency programs.
- g. Lists of key personnel to be contacted in times of emergency.
- h. Program to show compliance with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926 and various safety requirements of NPR 8715.3, NASA General Safety Program Requirements.
- i. Methods to comply with the requirement for immediate reporting of mishaps to the Contracting Officer in accordance with NPD 8621.1G.
- j. Statement that the Contractor will not invalidate the integrity of safety systems without proper authorization.
- k. Procedures for emergency actions to be taken to secure dangerous conditions, to protect personnel, and secure work areas in the event of accident or an act of nature.
- l. Procedures for securing the mishap site so that the area remains secure until arrival of a safety investigator. Mishap site will remain secured until released by the Contracting Officer.
- m. Provide MSDS sheets for all hazardous materials which will be used. Methods for handling and storage shall be identified.

1.3.2 Protection Plan

Structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations shall be protected against damage.

1.4 GENERAL SAFETY PROVISIONS

The GRC Safety Manual is available online at http://smad-ext.grc.nasa.gov/gso/manual/chapter_index.shtml

The Glenn Occupational Health Programs Manual is available online at <http://smad-ext.grc.nasa.gov/emo/pub/ohpm/ohpm-manual.pdf>.

Contractor shall take safety and health measures in performing work under this Contract. Contractor shall meet with the Contracting Officer to

develop a mutual understanding relative to administration of the safety plan. Contractor is subject to applicable federal, state, and local laws, regulations, ordinances, codes, and orders relating to safety and health in effect on the date of this Contract.

During the performance of work under this Contract, the Contractor shall comply with procedures prescribed for control and safety of persons visiting the project site. Contractor is responsible for his personnel and for familiarizing each of his subcontractors with safety requirements. Contractor shall advise the Contracting Officer of any special safety restriction he has established so that Government personnel can be notified of these restrictions.

1.5 SAFETY LOCKOUT/TAGOUT PROCEDURES

Contractor shall ensure that each employee is familiar with and complies with the Glenn Safety Manual, Chapter 9 and 29 CFR 1910.147.

Contracting Officer will, at the Contractor's request, apply lockout/tagout locks and tags and take other actions that, because of experience and knowledge, are known to be necessary to make the particular equipment safe to work on.

No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout locks and tags attached to it, nor shall such tag be removed except as provided in this section.

No person shall work on any equipment that requires a lockout/tagout locks and tags unless he, his immediate supervisor, project leader, or a subordinate has in his possession the stubs of the required lockout/tagout locks and tags.

When work is to be performed on electrical circuits, the work shall be performed only by personnel qualified observing the required safety clearance.

A supervisor who is required to enter an area protected by a lockout/tagout locks and tags will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.

Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.

Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks.

Pressurized or vacuum systems shall be vented to relieve differential pressure completely.

Vent valves shall be tagged open during the course of the work.

Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.

1.5.1 Tag Placement and Removal

Lockout/tagout locks and tags shall be completed in accordance with the regulations in Chapter 9 of the GRC Safety Manual and attached to any device which, if operated, could cause an unsafe condition to exist.

1.6 ACCIDENT TREATMENT AND RECORDS

Contractor shall post emergency first aid and ambulance information at project site.

Emergency response shall require the Contractor to call 911 on a NASA phone or 419 621-3222 on an outside line.

1.7 FIRE PREVENTION AND PROTECTION

Open-flame heating devices will not be permitted except by approval in writing from the Contracting Officer. Approval for the use of open fires and open-flame heating devices will not relieve the Contractor from the responsibility for any damage incurred because of fires.

Burning trash, brush, or wood on the project site shall not be permitted.

1.8 ELECTRICAL

Contractor shall appoint an individual responsible for the electrical safety of each work team to restrict entry to dangerous locations to those authorized by him jointly with the Government.

1.9 UNDERGROUND UTILITIES

Safety clearance and a confined space permit is required before any Contractor personnel enters a manhole.

The contractor shall be responsible for removing water and debris before commencement and during execution of work in manholes.

1.10 RADIATION SAFETY REQUIREMENTS

License Certificates for radiation materials and equipment shall be submitted by the Contracting Officer for all specialized material and equipment that could cause fatal harm to construction personnel or to the construction project.

Workers shall be protected from radiation exposure in accordance with 10 CFR 20. Standards for Protection Against Radiation

Loss of radioactive material shall be reported immediately to the Contracting Officer.

Actual exposure of the radiographic film or unshielding the source shall not be initiated until after 5 p.m. on weekdays.

In instances where radiography is scheduled near or adjacent to buildings or areas having limited access or one-way doors, no assumptions shall be made as to building occupancy. Where necessary, the Contracting Officer will direct the Contractor to conduct an actual building entry, search, and alert. Where removal of personnel from such a building cannot be accomplished and it is otherwise safe to proceed with the radiography, a

fully instructed employee shall be positioned inside such building or area to prevent exiting while external radiographic operations are in process.

1.11 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the Contracting Officer.

Contractor shall submit a Digging and Excavation Permit, GLF-H-1740.1, to the Government at least 5 working days prior to need. This permit must be approved by safety and environmental prior to work. Plum Brook's on-site contractor will field locate underground utilities and structures.

1.12 PROTECTION OF WORK

Prior to performing any excavation work or any surface penetrations 6 inches or deeper (such as driving stakes more than 6 inches in the ground) on any ground surface, the Contractor shall obtain the current subsurface utility drawing of the particular area to be worked on. The contractor shall stake out subsurface high voltage cables, communication cables, and pipe lines indicated within the scope of the work contemplated. After exposure, the Contractor shall obtain agreement from the Contracting Officer on how much closer to cable or pipe the excavations can be permitted.

Contractor shall notify the Contracting Officer, 48 hours prior to the start of excavation work or surface penetration, to enable the Contracting Officer to review measures being taken to prevent hazard to employees and possible damage to subsurface utilities. Where emergency conditions preclude the 48 hours advance notification, the Contractor shall immediately inform the Contracting Officer of his intention to initiate work prior to actual start of activity.

After obtaining clearance from the Contracting Officer, the Contractor shall proceed with excavating work, or other surface penetration work. Contractor, however, shall temporarily halt any machine excavation work or other surface penetration when approaching within 3 feet of the staked-out cable or pipe line until the Contractor has exposed the cable or pipe by hand excavation to fix its location.

Contractor shall submit a Confined Space Entry Permit, C-199, to the Government for approval 48 hours prior to entry.

1.13 GAS PROTECTION

Contractor shall have one or more employees properly trained in operation of gas testing equipment and formally qualified as gas inspectors who shall be on duty during times workmen are in confined spaces. Their primary functions shall be to test for gas and operate testing equipment. Unless equipment of constant supervisory type with automatic alarm is employed, gas tests shall be made at least every 2 hours or more often when character of ground or experience indicates gas may be encountered. A gas test shall be made before workmen are permitted to enter the excavation after an idle period exceeding one-half hour.

Readings shall be permanently recorded daily, indicating the concentration of gas, number and location of drilled piers, point of test, date, and time of test.

Special requirements, coordination, and precautions will apply to areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. A check by Government is required prior to entering confined space. Surveillance and monitoring shall be required in these types of work spaces by both Contractor and Government personnel.

1.14 ROOFING AND COATING

At the beginning of each work day the Contractor shall check with the Contracting Officer before proceeding to work on the roof to ensure safe work conditions.

1.15 WELDING, FLAME CUTTING, AND MELTING

Contractor shall clear welding and cutting operations with the Contracting Officer before operations begin.

Contractor shall discontinue burning, welding, or cutting operations 1 hour prior to the end of the normal work day. A workman shall remain at the site for 1 hour after discontinuing these operations to make thorough inspection of the area for possible sources of latent combustion. He shall be equipped with two full 15-pound carbon dioxide fire extinguishers. Any unsafe conditions shall be reported to the Safety Branch. Telephone: 419 621-3233.

During operations involving possible fire hazard, the Contractor shall notify the Contracting Officer and not proceed until clearance is obtained in writing. Contracting Officer may request a standby from the Safety Branch. This requirement does not relieve the Contractor of his responsibility for welding and cutting safety.

1.16 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, air compressors, and explosive device activated tools) shall be scheduled for weekends or after duty working hours, 4 PM to 12 AM. Use of any such equipment shall be approved in writing by the Contracting Officer prior to commencement of work.

1.17 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor shall:

- a. Secure outside equipment and materials and place materials possible to damage in protected locations.
- b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.
- c. Ensure that temporary erosion controls are adequate.

1.18 HAZARDOUS WASTE

Contractor shall identify all wastes produced and dispose of them in the following approved manners:

Identify all wastes and waste producing processes including chemicals, paints, POL products and solvents, and their containers. Unknown wastes will be chemically identified by the Government.

Obtain a determination of whether the waste is hazardous from the Contracting Officer.

Notify the Contracting Officer prior to taking disposal action for any hazardous waste.

For disposal, provide either laboratory analysis data documenting the chemical content of the waste or certification by appropriate organization authority as to the chemical constituents of the waste. Technical assistance on disposal analysis requirements will be provided on request by contacting the Contracting Officer.

Document the waste type, quantity, location, and personnel/contractor/agency responsible so the material can be tracked from generation through ultimate disposal as required by Environmental Protection Agency under Resource Conservation and Recovery Act.

1.19 CONFINED SPACE

Comply with the requirements in Chapter 16 of the GRC Safety Manual, 29 CFR 1910.146 and NHS/IHS 1845.2. Any potential for a hazard in the confined space requires a permit system to be used. Contractor shall submit a Confined Space Entry Permit, C-199, to the Government for approval 48 hours prior to entry.

- a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.
- b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained.
- c. Ensure the use of rescue and retrieval devices in confined spaces greater than 5 feet in depth.
- d. Manholes and excavations require continuous atmosphere monitoring with audible alarm for toxic gas detection and low oxygen levels.
- e. Include training information for employees who will be involved as entrant attendants for the work.
- f. Entry Permit. Use C-199, completed by the qualified person. Post the permit in a conspicuous place close to the confined space entrance.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 DAILY SITE INSPECTIONS

After the commencement of construction activities the competent person at the job site shall conduct daily site safety inspections. It will be the responsibility of the contractor to ensure site safety at all times. At the end of this section is a daily site safety inspection sheet that the contractor can use as a guide to completing the daily safety inspections. The contractor shall provide the records of the daily site safety checks at each progress meeting.

-- End of Section --

SECTION 01450

QUALITY CONTROL

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-06 Test Reports

Contractor shall submit the following items in accordance with the paragraph entitled, "Records," of this section.

Quality Control Data
Quality Control Coordinating Actions
Quality Control Training
Inspection Records
Letters of Authority or Delegation
Field Tests

SD-07 Certificates

Contractor shall submit a detailed written statement describing procedures that will be implemented to achieve quality on the project according to the paragraph entitled, "Quality Assurance (QA) Plan," of this section.

Contractor shall submit the following in accordance with the paragraph entitled, "Qualifications," of this section.

Contractor's Quality Representative Qualifications
Special Certifications

1.3.1 Quality Assurance (QA) Plan

QA plan shall address the following:

Description of the authority, responsibilities and coordinating procedures, of on-site/off-site quality assurance personnel, including those QA personnel not under direct control of the Contractor.

QA plan shall list personnel designated by the Contractor to accomplish the work required by the contract.

QA plan shall also contain an appendix with a copy of each form, report format, or similar record to be used in the QA program.

Contractor's organization that handles construction contract activities.

Contractor's operational plan for accomplishing and reviewing work controls, fabrication controls, certifications, and documentation of quality control operations, inspections, and test records, including those for subcontractors.

These provisions shall include the methods to be used during the procurement cycle (order to delivery) for those materials or equipment that require source inspections, shop fabrications, or similar operations located separately from the work site.

Description of on-site personnel training.

Certification(s) of personnel, procedures, processes, and equipment.

Nondestructive testing requirements.

Identification of independent certifying and testing laboratories.

1.3.2 Records

Records shall include all quality control data; factory tests or manufacturer's certifications, quality control coordinating actions; records of quality control training/certifications as well as routine hydrostatic, electrical continuity, grounding, welding, line cleaning, field tests and similar tests. Quality records shall be available for examination by the Contracting Officer.

Legible copies of the test and inspection records shall be furnished to the Contracting Officer. Records shall cover work placement traceable to the contract schedule, specifications and drawings, and shall be verified by the Contractor.

Contractor shall submit for approval, the narrative description of an inspection system which provides for compliance with the quality requirements and technical criteria of the contract within 7 days after notice to proceed.

Contractor shall submit a monthly performance report that summarizes the quality operations. This report shall identify inspections made, tests performed, nonconformances, corrective actions taken, status of plans/procedures being developed, and status of open items/problems in work.

Contractor shall submit Letters of Authority or Delegation outlining the authority and responsibilities of quality control personnel along with a copy of the letter of delegation to the Contracting Officer that defines delegated duties and responsibilities.

In-process inspection records and control away from the job site may be used as evidence of quality of materials/work and may reduce further inspection or testing after delivery to the job site.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor's Quality Representative Qualifications shall be submitted to

the Contracting Officer for approval. Quality Representative may be assigned to more than one contract provided that the assigned contracts are located at the same site.

When approval or certification of special processes, operating personnel, and special equipment or procedures is required by the specifications, the Contractor shall obtain necessary approvals or special certifications prior to starting the work.

1.4.2 Quality Control Requirements

Contractor shall provide a quality control program encompassing: selection of construction materials and sources; suppliers; subcontractors; on-site and off-site fabrication of Contractor-furnished assemblies; on-site and off-site assembly; erection; work procedures; workmanship; inspection; and testing.

Contractor's program shall provide document systems ensuring that quality provisions of contract schedule, specifications, and drawings have been performed.

1.4.2.1 Management and Organization

Contractor shall designate an individual within the on-site organization whose sole responsibility shall be the day-to-day on-site management and direction of the Quality Program.

The Quality Program Manager shall report to the Contractor's management and shall have the necessary authority to discharge contractual responsibilities.

1.4.2.2 Identification and Data Retrieval

Contractor shall have an identification and data retrieval system.

Records, drawings, submittals, and equipment shall be identified by referencing the Contract Number; Contract Specification Number; Contract Drawing Number; Submittal Document Number; Contract Change Number; and the Contractor's Drawing Number System.

1.4.2.3 Procurement

Contractor shall be responsible for controlling procurement sources and those of his subcontractors to ensure that each purchase meets quality requirements.

1.4.2.4 Receiving Inspection System

Contractor shall maintain a site receiving inspection system that ensures procured materials and equipment are inspected and tested.

Receiving inspection records shall accompany each procurement delivery to the construction site. Records of site receiving inspections shall be maintained by the Contractor.

Records shall show defects, discrepancies, dispositions, and waivers, including evidence of Government source inspection.

1.4.2.5 Nonconforming Articles and Material Control

The Contractor shall control nonconformances discovered by the Contractor, subcontractors, suppliers or Government quality representatives to prevent their use and to correct deficient operations.

- a. Contractor shall prepare a "nonconformance" report for each instance comprising:
 - (1) A unique and traceable number.
 - (2) Identification of the nonconforming article or material.
 - (3) A description of the nonconformance and the applicable requirement.
 - (4) Cause or reason for the nonconformance.
 - (5) Remedial actions taken or recommended.
 - (6) Disposition of the nonconforming article or material.
- b. The Contractor shall identify and mark each nonconforming article for removal from the work area.
- c. The Contractor shall monitor and correct deficient operations.

1.4.2.6 Fabrication, Process, and Work Control

Contractor's procedures and controls shall ensure compliance with requirements in contract specifications and drawings.

Contractor shall establish in-process inspections, to ensure compliance with quality requirements.

1.4.2.7 Quality Control Records

Quality control records shall be maintained at a central on-site location.

Maintenance of quality control records shall not relieve the Contractor from submitting samples, test data, detail drawings, material certificates, or other information required by each section in the specification.

Contractor shall ensure each record is identified and traceable to specific requirements in the specifications and drawings.

1.4.2.8 Drawings and Change Control

Drawing-control system shall be maintained to provide revised drawings and ensure continuous removal of obsolete drawings from work areas. Changes involving interface with other work areas, or affecting materials controlled by others shall be controlled by the Contractor. This system shall be integrated with the document requirements of the contract.

Drawing changes shall be clearly annotated. Implemented changes shall be clearly identified and associated drawings shall be revised accordingly. Drawings that have been approved, or approved as noted, by the Contracting Officer shall be used for fabrication and inspection.

1.4.3 Quality Inspections

1.4.3.1 Government Inspections

Work performed under this contract will be subject to inspection by the Contracting Officer. Changes to the specifications or drawings will not be allowed without written authorization of the Contracting Officer.

When the Contracting Officer determines that inspected work needs to be corrected, the Contracting Officer will be allowed 24 hours to complete reinspection of the corrected work.

Contracting Officer shall also be notified in writing before backfilling or encasing any underground utility so that work may be inspected. Failure to notify the Contracting Officer before backfill or encasement occurs shall require the work be uncovered at no additional cost to the Government.

Contractor's program is subject to continuous evaluation, review, and verification by the Contracting Officer. Contractor will be notified in writing of any noncompliance and will be given 7 days to correct identified deficiencies.

1.4.3.2 Contractor's Quality Inspections

Contractor shall implement an inspection system. Documentation shall indicate quality control through records of inspections, tests, and procedures.

Contractor's quality assurance system shall include the following:

- a. Single Contractor's representative responsible for on-site communication and operation of the inspection program.
- b. Purchasing control system documenting project procurement to drawings, specifications, and approved submittals.
- c. Receiving inspection system documenting inspections for each procurement.
- d. Documentation for handling and disposing of nonconforming components and materials.
- e. Inspection records for each specific section of the specification and drawings.
- f. Identification of test(s) to be performed, test procedures, records, and independent organizations used.
- g. Documenting and maintaining certification or re-certification of procedures.
- h. Management of government-furnished equipment, components, and materials.
- i. Calibration of gages, tools, measuring instruments, and independent laboratories used.

Contractor shall establish a system of scheduled or random audits to ensure task completion.

1.4.4 Field Services

1.4.4.1 Responsibility for Inspection and Testing

Contractor shall be responsible for all inspections and tests, and the accompanying documentation for each inspection and test. Contractor may utilize independent inspection and testing laboratories or services as approved by the Contracting Officer.

Contractor shall also be responsible for tests of construction materials utilizing the services of an approved independent testing laboratory.

1.4.4.2 Inspection and Test Records

Contractor shall provide on-site records of each inspection and test performed throughout the life of the contract. Records shall include, but not be limited to, factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved, identification of operators and inspectors, result of inspections or tests, nature of defects, causes for rejection, proposed remedial action, and corrective actions taken.

Inspection records, test procedures, test results, and associated forms will be verified by the Contracting Officer.

1.5 HANDLING AND STORAGE

Contractor shall provide controls, procedures and documentation with each shipment, that meet requirements of each section of the specifications.

The Contractor shall include documentation with each shipment. The data shall consist of documentation required by the contract along with specifications required to identify, store, preserve, operate, and maintain the items shipped.

1.6 SEQUENCING AND SCHEDULING

Contractor shall notify the Government at least 48 hours prior to scheduled inspections and tests.

Contractor shall provide 3 weeks notice to the Government of the date when the contract work will begin at the site.

When Contractor suspends work for 1 day or longer prior to completion, the Contracting Officer shall be notified. Work shall not resume without notification of the Contracting Officer.

Contracting Officer shall be notified at least 72 hours in advance of backfilling or encasing any underground utility.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component of, each section of the specifications.

1.2 SUBMITTALS (Not Applicable)

PART 2 PRODUCTS

2.1 CONSTRUCTION SIGN

Contractor shall provide a construction identification sign.

Sign shall comprise a face sheet of 4- by 8-foot exterior grade plywood, 1/2-inch thick, mounted on a substantial frame of treated lumber. Frame and sign shall be given one coat of lead-free alkyd primer paint and two coats of an exterior type white enamel.

2.2 CONSTRUCTION DETAILS

Lettering and further details of construction shall be in accordance with the drawings.

PART 3 EXECUTION

3.1 TEMPORARY UTILITIES

Contractor shall provide temporary utilities required for construction. Materials may be new or used, shall be adequate for the required usage, shall not create unsafe conditions, and shall not violate applicable codes and standards.

3.1.1 Electricity

Contractor shall provide connections, sized to provide service required for power and lighting. Feeder and branch wiring with area distribution boxes shall be located so that power is available throughout the project site by use of power cords. 120/240 electrical volt feeder service is available. Lighting shall be provided by the Contractor. Electricity used will be furnished by the Government.

3.1.2 Water

Contractor shall make connections to existing facilities to provide water for construction purposes. Water used will be furnished by the Government.

3.1.3 Telephone Service

Contractor shall provide telephone service. Contractor shall pay costs of service.

3.1.4 Sanitary Facilities

Contractor shall provide temporary sanitary facilities and shall service, clean, and maintain these facilities and enclosures. Temporary facilities shall be removed from the site at the completion of the work.

3.1.5 Fire Protection

Contractor shall provide temporary fire protection equipment for the protection of personnel and property during construction. Debris and flammable materials shall be removed daily to minimize potential hazards.

3.2 SIGNS

3.2.1 Construction Sign

Within 30 days after notice to proceed, the Contractor shall install the construction identification sign at the location designated by the Contracting Officer.

3.2.2 Other Signs and Advertisements

Only signs necessary to expedite deliveries, maintain traffic flow, promote safety (e.g. caution, danger, blasting, hardhat area), and prevent interference with Government operations shall be erected.

3.3 TRAFFIC PROVISIONS

3.3.1 Maintenance of Traffic

Contractor shall conduct his operations in a manner that will not close any thoroughfare or interfere in any way with traffic on railways or highways except with written permission of the Contracting Officer. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

Work shall be conducted so as to minimize obstruction of traffic, and traffic shall be maintained on at least half of the roadway width at all times. Approval shall be obtained from the Contracting Officer prior to starting any activity that will obstruct traffic.

Contractor shall provide, erect, and maintain, at his own expense, lights, barriers, signals, passageways, detours, etc., that may be required.

3.3.2 Rush Hour Restrictions

Contractor shall not interfere with the peak traffic flows preceding and during normal operations from 7:00 a.m. to 5:00 p.m. without notification to and approval by the Contracting Officer.

3.3.3 Dust Control

Contractor's dust control methods and procedures shall be approved by the Contracting Officer. Dust abatement on access roads shall be treated with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.4 TEMPORARY STRUCTURES

Contractor-owned or -leased trailers shall be identified with the name and phone number of the Contractor. Size and location of signage shall be approved by the Contracting Officer.

3.5 PROTECTION OF EXISTING SYSTEMS

3.5.1 Utility

Connection to existing utilities, identified on the drawings to the Contractor, shall be protected from damage during construction activity.

3.5.2 Safety

Contractor shall protect the integrity of any installed safety systems or personnel safety devices.

If entrance into systems serving safety devices is required, the Contractor shall obtain prior approval from the Contracting Officer. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, the Contractor shall provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and shall obtain prior approval from the Contracting Officer.

3.6 DRAINAGE AND EROSION CONTROL

Contractor shall submit 6 copies of the proposed construction plan addressing erosion, sediment and drainage control to the Government.

-- End of Section --

SECTION 01575

TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4439	(2004) Standard Terminology for Geosynthetics
ASTM D 4491	(1999; R 2004) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 2003) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4873	(2002) Identification, Storage, and Handling of Geosynthetic Rolls

1.2 GENERAL

The Contractor shall implement the storm water pollution prevention measures specified in this section in a manner which will meet the requirements of Section 01 35 43 98 ENVIRONMENTAL PROTECTION PROCEDURES.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Silt Fence
 Inlet Protection
 SWP3 Implamentation Plan
 [_____]

Certificate attesting that the Contractor has met all specified requirements.

1.4 EROSION AND SEDIMENT CONTROLS

The controls and measures required by the Contractor are described below.

1.4.1 Stabilization Practices

The stabilization practices to be implemented shall include [temporary seeding,] [mulching,] [geotextiles,] [erosion control mats,] [protection of trees,] [preservation of mature vegetation,] [etc]. The contractors daily reports, shall record the dates when major grading activities occur, (e.g., clearing, grubbing, excavation, embankment, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. DISTURBED SOILS THAT WILL BE DORMANT FOR LONGER THAN 21 DAYS SHALL BE PROTECTED AS FOLLOWS:

If within 50 ft of a waterway, as determined by the NASA COTR, stabilization must start within two(2) days of the last disturbance of the area.

if beyond 50 ft of a waterway, as determined by the NASA COTR, stabilization must start within seven(7) days of the last disturbance of the area.

1.4.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the 7th day after construction activity temporarily or permanently ceases is precluded by unsuitable conditions caused by the weather, stabilization practices shall be initiated as soon as practicable after conditions become suitable.

1.4.1.2 No Activity for Less Than 21 Days

Where construction activity will resume on a portion of the site within 21 days from when activities ceased (e.g., the total time period that construction activity is temporarily ceased is less than 21 days), then stabilization practices do not have to be initiated on that portion of the site by the 7th day after construction activity temporarily ceased.

1.4.2 Structural Practices

Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Structural practices shall include the following devices. [Location and details of installation and construction are shown on the drawings.]

1.4.2 [Silt Fences

The Contractor shall provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Silt fences shall be properly installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Final removal of silt fence barriers shall be upon approval by the COTR. [Silt fences shall be installed in the locations indicated on the drawings.] [Silt fence shall be provided as follows.]

- a. Along the downhill perimeter edge of all areas disturbed.
- b. Along the top of the slope or top bank of drainage ditches,

channels, swales, etc. that traverse disturbed areas.

c. Along the toe of all cut slopes and fill slopes of the construction areas.

d. Perpendicular to the flow in the bottom of existing drainage ditches, channels, swales, etc. that traverse disturbed areas or carry runoff from disturbed areas. Rows shall be spaced [a maximum of [_____] feet apart] [as shown on the drawings].

e. Perpendicular to the flow in the bottom of new drainage ditches, channels, and swales. Rows shall be spaced [a maximum of [_____] feet apart] [as shown on the drawings].

f. At the entrance to culverts that receive runoff from disturbed areas.

g. [_____] .]

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES

2.1.1 Filter Fabric

The geotextile shall comply with the requirements of ASTM D 4439, and shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall meet the following requirements:

FILTER FABRIC FOR SILT SCREEN FENCE

PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT
Grab Tensile Elongation (%)	ASTM D 4632	100 lbs. min. 30 % max.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

2.1.2 Silt Fence Stakes and Posts

The Contractor may use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 inches by 2 inches when oak is used and 4 inches by 4 inches when pine is used, and shall have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 5 feet.

2.1.3 Mill Certificate or Affidavit

A mill certificate or affidavit shall be provided attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above. The mill certificate or affidavit shall specify the actual Minimum Average Roll Values and shall identify the fabric supplied by roll identification numbers. The Contractor shall submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the filter fabric.

2.1.4 Identification Storage and Handling

Filter fabric shall be identified, stored and handled in accordance with ASTM D 4873.

2.2 COMPONENTS FOR INLET PROTECTION

Text

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCES

Silt fences shall extend a minimum of 16 inches above the ground surface and shall not exceed 34 inches above the ground surface. Filter fabric shall be from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter fabric shall be spliced together at a support post, with a minimum 6 inch overlap, and securely sealed. A trench shall be excavated approximately 6 inches wide and 6 inches deep on the upslope side of the location of the silt fence. The 6-inch by 6-inch trench shall be backfilled and the soil compacted over the filter fabric. Silt fences shall be removed upon approval by the Contracting Officer.

3.2 INSTALLATION OF INLET PROTECTION

Text

3.3 MAINTENANCE

The Contractor shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. The following procedures shall be followed to maintain the protective measures.

3.3 Silt Fence Maintenance

Silt fences shall be inspected in accordance with paragraph INSPECTIONS. Any required repairs shall be made promptly. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, the fabric shall be

replaced promptly. Sediment deposits shall be removed when deposits reach one-third of the height of the barrier. When a silt fence is no longer required, it shall be removed. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall [receive erosion control if required by Section [02__ EROSION CONTROL]], paragraph [AREAS TO RECEIVE EROSION CONTROL] [be seeded in accordance with Section [02__]] [ESTABLISHMENT OF TURF], [except that the coverage requirements in paragraph ESTABLISHMENT do not apply].

3.4 INSPECTIONS

3.4.1 General

The Contractor shall inspect disturbed areas of the construction site, areas used for storage of materials that are exposed to precipitation that have not been finally stabilized, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every month until the site is determined to be stabilized by the COTR.

3.4.2 Inspections Details

Disturbed areas and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan shall be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.

3.4.3 Inspection Reports

All inspection reports shall include the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. The report shall be furnished to the Contracting Officer within 24 hours of the inspection as a part of the Contractor's daily report. A copy of the inspection report shall be maintained on the job site.

-- End of Section --

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS (Not Applicable)

1.4 SHIPMENT AND PROTECTION OF MATERIAL AND EQUIPMENT

Shipments shall be addressed to the Contractor who shall be responsible for their receipt, unloading, handling, and storage at the site. Government will not accept deliveries on behalf of the Contractor or his subcontractors or assume responsibility for security of materials, equipment, or supplies delivered to the site.

Contractor shall protect and preserve materials, supplies, and equipment of every description (including property which may be Government-furnished or -owned) and work performed.

1.5 STORAGE AND PROTECTION OF MATERIAL

1.5.1 Salvage Material

Material to be salvaged and reinstalled by the Contractor shall be protected during removal and stored to prevent damage.

1.5.2 New Material and Construction Equipment

Only material and construction equipment designated for performance of contract work may be stored at the construction site or located in Government-controlled warehouses or shop facilities.

PART 2 PRODUCTS

2.1 MECHANICAL MATERIALS AND EQUIPMENT

Materials and equipment to be provided under this contract shall be standard catalogue products of manufacturers regularly engaged in the manufacture of the products.

Material and equipment shall be installed in accordance with the requirements of the contract drawings and approved recommendations of the manufacturers.

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01780

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-10 Operation and Maintenance Data

Preventative Maintenance and Inspection schedules shall be submitted by the Contractor with instructions that state when systems should be retested.

Schedule shall define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements. Each test feature; e.g., gallons per minute, rpm, psf, shall have a sign-off blank for the Contractor and Contracting Officer. A remarks column of the testing validation procedure shall include references to operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair shall be delineated.

Repair requirements shall inform operators how to check out, troubleshoot, repair, and replace components of the system.

Instructions shall include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

Posted instruction shall be submitted by the Contractor with labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the product for normal, safe operation.

Contractor shall submit 6 copies of the project Operation and Maintenance Manuals 30 days prior to testing the system involved. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

SD-11 Closeout Submittals

As-Built Drawings shall be submitted under the following criteria:

In order to minimize the time for final payment at the completion of the project, the Contractor shall update the as-built drawings every month with the Contracting Officer's authorized representative. This update will be a part of "the monthly request for payment meeting," and payment -- or a portion of the payment, including final payment -- may be withheld until the as-built drawings have been updated, and accepted by the Contracting Officer.

After completion of all construction and before final payment is made under this contract, the Contractor shall provide the Contracting Officer with one complete set of full-size blue-line contract drawings with alterations shown in red pencil.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 OPERATION AND MAINTENANCE

Operation and Maintenance Manuals shall be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Information shall be bound in manual format and grouped by technical sections. Test data shall be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals shall have 10 millimeter holes and be bound in 3-ring, loose-leaf binders. Data shall be organized by separate index and tabbed sheets, in a loose-leaf binder. Binder shall lie flat with printed sheets that are easy to read. Caution and warning indications shall be clearly labeled.

-- End of Section --

SECTION 02312

EXCAVATION, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

- AASHTO M 145 (1991; R 2003) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
- AASHTO T 180 (2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- AASHTO T 2 (2000) Sampling of Aggregates
- AASHTO T 87 (1986; R 2000) the Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test

ASTM INTERNATIONAL (ASTM)

- ASTM C 136 (2001) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- ASTM D 1556 (2000) Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
- ASTM D 2922 (2001) Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- ASTM D 3740 (2001) Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used In Engineering Design and Construction
- ASTM D 422 (2002) Standard Test Method for Particle-Size Analysis of Soils
- ASTM D 4318 (2000) Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

- AWPA C1 (2003) All Timber Products - Preservative Treatment by Pressure Processes

AWPA C3

(1991) Piles - Preservative Treatment by
Pressure Processes

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Record of Existing Conditions shall be submitted in accordance with the paragraph entitled, "Records of Existing Conditions," of this section.

The records shall include the following:

Location of Underground Utilities
Location of Approved Utilities
Location of Test
Location of Inspection

SD-02 Shop Drawings

As-Built Drawings shall be submitted in accordance with paragraph entitled, "Drawings," of this section.

SD-06 Test Reports

Test reports shall be submitted in writing by the Contractor for Soil Test results within 3 working days. Reports shall be according to the paragraph entitled, "Field Quality Control," of this section.

SD-07 Certificates

Certificates for the following shall be submitted by the Contracting Officer in accordance with the paragraph entitled, "Plans," of this section.

Demolition Plan
Work Plan
Protection Plan

Certificates for Proposed Soil Materials shall be submitted by the Contracting Officer in accordance with paragraph entitled, "Proposed Soil Materials," of this section.

Certificates for Compost shall be submitted indicating grade and compliance to state and local regulations.

1.3 QUALITY ASSURANCE

Soil survey for satisfactory soil materials and samples of soil materials shall be furnished by the Contractor. A certified soil-testing service approved by the Contracting Officer shall be provided by the Contractor. Testing shall include soil survey for satisfactory soil materials, sampling and testing soil materials proposed for use in the work, subbase materials

at the mixing plant, and field-testing facilities for quality control during construction period.

Testing agencies shall conform to the requirements of ASTM D 3740.

1.4 PLANS

The Demolition Plan shall be approved by the Contracting Officer at least 48 hours in advance of the work. The plan shall include all special environmental consideration and safety precautions along with the coordination procedures for the protection plan and work plan of this phase of work.

A Work Plan shall be submitted including proposed methods of excavation, earth support, utility construction, and backfilling at least 48 hours in advance of the work, for approval by the Contracting Officer. The plan shall be coordinated with the demolition and protection plans of this section.

The Contractor shall provide a Protection Plan of existing utilities place, and coordinate the plan with the demolition plan.

1.5 DRAWINGS

As-Built Drawings shall be submitted in accordance with Section 01780, "Closeout Submittals."

1.6 RECORDS OF EXISTING CONDITIONS

The Contractor shall verify the existing conditions are correct as shown on the plans and mentioned in the specification. Any discrepancies found shall be noted immediately, and notification given to the Contracting Officer.

The records shall include Location of Underground Utilities, Location of Approved Utilities, Location of Test and Location of Inspection.

PART 2 PRODUCTS

2.1 STRUCTURAL MATERIALS

Materials used for shoring and bracing, such as sheet piling, uprights, stringers, and crossbraces, shall be in good serviceable condition. Any timber used shall be sound and free from large or loose knots.

Pressure-treated timber shall be used where wood sheeting or piling is specified or indicated to be cut and left in place. Timber and treatment shall conform to AWWA C1. Pressure treatment for piles shall conform to AWWA C3.

2.2 BACKFILL MATERIAL

Backfill material shall consist of sandy clay, sand, gravel, soft shale, or other satisfactory soil materials. If material is brought on-site for backfill, chemical analytical data must be provided to the PBS Environmental Manager in advance for review and approval to ensure that "clean" soil is being used.

2.2.1 Proposed Soil Materials

Soil materials proposed for use in the work shall be tested. The materials shall be approved by the Contracting Officer prior to start of work, as follows:

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Satisfactory soil materials	Sampling	AASHTO T 2	One for each source of material to determine conformance to definition of satisfactory soil materials; additional tests whenever there is any apparent change
	Preparation of samples	AASHTO T 87	
	Sieve analysis of fine and coarse aggregate	ASTM C 136	
	Mechanical analysis of soils	ASTM D 422	
	Liquid limit of soils	ASTM D 4318	
	Plastic limit and plasticity index of soils	ASTM D 4318	
	Moisture-density relations of soil	AASHTO T 180, Method B or D	

2.2.2 Satisfactory Materials

Satisfactory soil materials - AASHTO M 145 Soil Classification Groups A-1, A-2-4, A-2-5, and A-3.

2.2.3 Unsatisfactory Materials

Unsatisfactory soil materials - AASHTO M 145 Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7, highly organic soils, and soil materials of any classification that have a moisture content at the time of compaction beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

2.3 TOPSOIL

Topsoil shall be any soil removed from the project site which consists of clay or sandy loam. The topsoil shall be reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and shall be free from stones, stumps, roots, and other objectionable materials larger than 2 inch in any dimension.

2.4 COMPOST

Compost shall be yard trimmings or yard waste compost processed and graded according to state and local regulations.

2.5 TOPSOIL BLEND

Where insufficient topsoil is removed from the project site the topsoil removed shall be stockpiled and blended with compost at the site to achieve the required volume.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Before starting earthwork, the location of underground utilities shall be carefully verified by hand methods. Utilities to be left in place shall be protected from damage.

Excavation, filling, backfilling, and grading shall be to subgrade elevations specified.

Excavated materials suitable for backfill shall be piled in an orderly manner sufficiently distant from excavations to prevent overloading, slides, and cave-ins.

Excavations shall be done in ways that will prevent surface water and subsurface water from flowing into excavations and will also prevent flooding of the site and surrounding area.

3.2 PROTECTION OF PERSONS AND PROPERTY

Excavations shall be barricaded and posted with warning signs for the safety of persons. Warning lights shall be provided during hours of darkness.

Structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations shall be protected against damage including settlement, lateral movement, undermining, and washout.

Where existing utilities and structures are indicated as being in the line of the proposed improvement, the Contractor shall expose them, as directed by the Engineer/Architect. This work is to be done sufficiently in advance of the construction operations to permit adjustments in line or grade, if required to eliminate interferences. Existing pipes or conduits crossing the trench or otherwise exposed, shall be adequately braced and supported to prevent trench settlement from disrupting the line or grade of the pipe or conduit, all in accordance with the directions of the Engineer/Architect. Utility services broken or damaged shall be repaired at once to avoid inconvenience to customers and utility owners. Temporary arrangements, as approved by the Engineer/Architect, may be used until and damaged items can be permanently repaired. All items damaged or destroyed by construction and subsequently repaired must be properly maintained by the Contractor.

Where it is necessary to relocate an existing utility or structure, the work shall be done in such a manner as is necessary to restore it to a condition equal to that of the original facility. No such relocation shall be done until approval is received from the authority responsible for the utility or structure being changed.

If an interference is encountered at grade with utilities or structures not shown on the plans or otherwise indicated, the authorized elimination of the interference shall be paid for in accordance with the Changes in

Contract Price of the General Conditions.

Topsoil removal operations shall be conducted to ensure safety of persons and to prevent damage to existing structures and utilities, construction in progress, trees and vegetation to remain standing, and other property.

3.3 SHORING, BRACING, AND SHEETING

Shoring and bracing in excavations shall be maintained for the entire length of time excavations will be open. Shoring and bracing shall be carried down with the excavation.

Sheeting used to prevent lateral movement of soil shall be removed in accordance with the requirements.

Untreated sheeting shall not be left in place beneath structures or pavements.

3.4 TRENCH EXCAVATION

Trenches shall be of adequate width and depth for the specified purpose. Side slopes of the trenches shall be as nearly vertical as practicable. Care shall be taken not to overexcavate. Bottoms of the trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length except where it is necessary to excavate for bell holes and for proper sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded to ensure that the pipe rests on the prepared bottom for as much of its full length as practicable. Bell holes and depressions shall be only of such length, depth, and width as required to make the joint. Stones shall be removed, as necessary, to avoid point bearing. Where rock excavation is required in trenches for pipe, the rock shall be excavated to a minimum overdepth of 6-inches below the trench depth specified. Except as specified for wet or otherwise unstable material, overdepths shall be backfilled with materials specified for backfilling the lower portion of trenches. Whenever wet or otherwise unstable material that is incapable of properly supporting the pipe, as determined by the Contracting Officer, is encountered in the bottom of the trench, it shall be removed and the trench shall be backfilled to the proper grade with coarse sand, fine gravel, or other suitable, approved material.

Trench excavations in surfaced areas shall be by open cut, unless otherwise shown. The pavement shall be cut by concrete saw or other approved method. Cuts shall be in straight lines parallel to the utility line location and shall be to a depth of at least one quarter of the pavement thickness. The remainder of the pavement shall be broken out. Pavement shall be removed a minimum of 12 inches on each side of the trench and 6 inches beyond where the base course is to be removed.

3.5 WATER REMOVAL

Water shall not be permitted to accumulate in excavations. Dewatering systems shall be provided by the Contractor to convey water away from excavations so that softening of foundation bottoms, footing undercutting, and soil changes detrimental to subgrade stability and foundation will not occur. Dewatering systems and methods of disposal shall be approved by the Contracting Officer.

Dewatering shall be continued until construction subject to water pressure has obtained full specified strength and backfill is completed.

Water removal from excavations shall be conveyed to approved collecting or runoff areas. Temporary drainage ditches and other diversions as necessary shall be provided and maintained outside of excavation limits.

Trench excavations for utilities shall not be used for temporary drainage ditches.

3.6 EXCAVATION FOR WATER DISTRIBUTION SYSTEM

Trenches shall be graded to avoid high points that necessitate placing vacuum and relief valves in the waterlines. If a profile of the pipes is not provided, trenches shall be of a depth to provide a minimum cover over the top of the pipe of 4 feet 6 inches from the existing ground surface or the indicated finished grade (whichever is lower) and at additional depth if necessary to avoid interference of the waterlines with other utilities.

3.7 EXCAVATION FOR ELECTRICAL UTILITIES

Excavation of trenches for electrical cables and duct lines shall provide vertical walls, unless otherwise approved by the Contracting Officer, and the trench shall be only as wide as necessary for workers to install the cables or ducts. Abrupt changes in grade of the trench bottom shall be avoided. Trenches shall be of a depth to provide a minimum cover over the top of the cables or ducts of 2 feet below finished grade, and at additional depth if necessary to avoid interference of the electrical cables or ducts with other utilities.

3.8 EXCAVATION FOR APPURTENANCES

Excavation for manholes and similar structures shall be sufficient to leave at least 12 inches in the clear between the outer surfaces and the embankment or timber used to hold and protect the walls. Any overdepth excavation below such appurtenances that has not been directed will be considered unauthorized and shall be refilled with select bedding material or concrete, as directed by the Contracting Officer, at no additional cost to the Government.

3.9 BACKFILLING AND COMPACTION

Where trench sheeting is pulled, withdrawal shall be in increments of not more than 1 foot and backfilling and compaction operations shall be carried on simultaneously with trench sheeting pulling.

Trenches shall not be backfilled until required tests are performed and until the utilities systems, as installed, conform to the requirements for the installation of the various utilities. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified, or the condition shall be otherwise corrected as directed.

3.9.1 Bedding

Where the trench is excavated in rocks, a minimum of 6 inches of specified bedding material shall be placed on the rock surface before laying conduit or electrical cable. The word "rock," wherever used as the name of an excavated material, shall mean boulders and solid masonry larger than 1/2

cubic yard in volume, or solid ledge rock and masonry which requires for its removal, drilling and blasting, wedging, sledging, barring, or breaking up with a power operated hand tool. Any material which can be excavated using a hand pick and shovel, power operated excavator, power operated backhoe, or power operated shovel shall not be defined as rock.

3.9.2 Backfill Around Pipe

Where the water main trench is underneath or within the 1:1 zone of influence of edge of paved areas such as roadways, parking lots, sidewalks, etc., bedding material shall be ODOT NO. 8 limestone to 6 inches above the top of the water main. Backfill outside of the zone of influence of the paved areas bedding material shall be sandy clay, sand, gravel, soft shale, or other approved materials free of hard clods and stones larger than 2 inches in any dimension.

3.9.3 Lower Portion of Trench

Backfill material shall be deposited in 8 inch uncompacted layers and compacted to the density of the adjacent soil until there is a cover of not less than 12 inches. The backfill material in this portion of the trench shall consist of ODOT Item 304 limestone within paved areas, or sandy clay, sand, gravel, soft shale, or other approved materials, free from hard clods and stones larger than 1 inch in any dimension. See Trench Details in Plans.

3.9.4 Remainder of Trench

The remainder of the trench shall be backfilled with ODOT Item 304 limestone if within paved areas, or material that is free of stones larger than 3 inches in any dimension. Backfill material shall be deposited in layers not exceeding the thickness specified, and each layer shall be compacted to the minimum density specified. See Trench Details in Plans.

Under concrete slabs and paved parking areas:

6-inch layers, 95 percent of maximum density prescribed in AASHTO T 180, Method B or D

Under other areas:

8-inch layers, 90 percent of maximum density prescribed in AASHTO T 180, Method B or D

3.9.5 Bulkheads

When a granular bedding is provided or when granular backfill is required, the Contractor shall place bulkheads of clay soil across the trench at 100 foot intervals to resist the movement of groundwater through the granular material. Such bulkheads shall be carefully compacted and shall extend approximately 3 feet in a direction parallel to the pipe and shall extend from the bottom of the trench to a height of 6 inches above the top of the pipe barrel.

3.10 FIELD QUALITY CONTROL

The Contractor shall arrange his Soil Test work so that sampling and testing may be performed without interruption. Moisture-density relations shall be determined in accordance with AASHTO T 180, Method B or D. Field

density tests shall be performed by methods in sufficient number to ensure that the specified density is obtained.

Soil materials shall be tested during construction as follows:

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>MATERIAL TESTED AND NUMBER OF TESTS</u>
Soil material-in-place after compaction	Density of soil-in-place	ASTM D 1556, Sand Cone Method or ASTM D 2922, Nuclear Method (when approved by Contracting Officer)	At least three daily for each subgrade soil material, and for each layer of soil material; additional test whenever there is in moisture

3.11 RESTORATION OF SURFACES

Areas within the limits of earthwork under this section, including adjacent transition areas, shall be uniformly graded. The finished surface shall be smooth within the specified tolerances, compacted, and with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

Grassed areas:

The finished surface of areas to receive topsoil blend shall be not more than 1.25 inches above or below the specified finish elevations.

Walks:

The surface of areas under walks shall be shaped to line, grade, and cross section, and the finished surface shall be not more than 0.0 foot above or 1.25 inches below the specified finish elevations.

Pavements:

The surface of areas under pavements shall be shaped to line, grade, and cross section, and the finished surface shall be not more than 1/2-inch above or below the specified finish elevations.

3.12 DISPOSAL OF EXCESS AND WASTE MATERIALS

Excess excavated satisfactory materials shall be transported to, and disposed in, designated storage areas on Government property.

Waste materials, including excavated material classified as unsatisfactory soil material, trash, and debris, shall be removed from Government property and legally disposed of, by the Contractor.

-- End of Section --

SECTION 02515

WATER SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ASTM INTERNATIONAL (ASTM)

ASTM A 536	(1994) Standard Specification for Ductile Iron Castings
ASTM B 88	(2003) Standard Specification for Seamless Copper Water Tube

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104	(1990; 1st Ed) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (76 mm through 1219 mm), for Water Erratum: October 1999
AWWA C111	(2000) Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(2002) Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids
AWWA C153	(2000) American National Standard for Ductile Iron Compact Fittings, 3 In. through 24 In., and 54 In. through 64 In. for Water Service
AWWA C502	(1994; Addendum C502A - 1995) Dry-Barrel Fire Hydrants
AWWA C509	(2001) Resilient-Seated Gate Valves for Water-Supply Service
AWWA C651	(1999) Disinfecting Water Mains

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

The following drawing types shall be submitted in accordance with

paragraph entitled, "Shop Drawings," of this section.

Erection/Installation Drawings
As-Built Drawings

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Ductile-Iron Pipe
Pipe Connections
Rubber Gaskets
Copper Tubing
Plastic Pipe and Fittings
Gate Valves
Vacuum and Relief Valves
Tapped Tees
Corporation-Type Stops
Goosenecks
Service Stops
Service Boxes
Valve Manholes
Fire Hydrants

SD-06 Test Reports

Test reports for the following items shall be submitted in accordance with the paragraph entitled, "Testing," of this section.

Hydrostatic Test
Pressure Test
Leakage Test
Sterilizing

SD-08 Manufacturer's Instructions

Manufacturer's instructions including special provisions required to install equipment, components, and systems packages shall be submitted for the following. Special notices shall detail impedances, hazards and safety precautions.

Pipe Connections
Rubber Gaskets
Plastic Pipe and Fittings
Gate Valves
Vacuum and Relief Valves
Tapped Tees
Corporation Stops
Service Stops
Service Boxes
Valve Manholes
Fire Hydrants

1.3 LIMITS OF CONSTRUCTION

Work in this section relates to excavation, fill, and backfill to a point 5 feet beyond the building or structure line.

1.4 SHOP DRAWINGS

Erection/Installation Drawings shall be submitted by the Contractor for the complete water system prior to start of work.

As-Built Drawings shall be submitted by the Contractor for the completed water system improvements upon completion of the work. For areas where installation was provided by directional drilling, as-built data including horizontal and vertical location of the pipe line at 50-foot intervals shall be provided. For areas where pipelines were laid in trenches, horizontal and vertical location of the pipelines at 100 foot intervals shall be included in the as-built drawings.

PART 2 PRODUCTS

2.1 PIPING

2.1.1 Ductile-Iron Pipe

Ductile-iron pipe shall meet the requirements of ANSI/AWWA C151/A21.51, "Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids."

1. Material -- The chemical constituents shall meet the physical property recommendations of ASTM A 536, "Ductile Iron Castings," to ensure that the iron is suitable for satisfactory drilling and cutting.
2. Minimum Thickness -- Unless otherwise shown, the minimum thickness of the barrel of the pipe shall be:

<u>Size</u>	<u>Thickness</u>
3" - 24"	52
30" - 48"	53

3. Coating and Lining -- The pipe shall be coated outside with a bituminous coating in accordance with ANSI/AWWA C151/A21.51. "Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids," and lined inside with cement mortar and seal coated in accordance with ANSI/AWWA C104/A21.4, "Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water."

2.1.2 Ductile Iron Fittings

Ductile iron standard and special fittings shall conform to ANSI/AWWA C110/A21.10, "Ductile Iron and Gray Iron Fittings, 3 Inches through 48 Inches, for Water and Other Liquids," or ANSI/AWWA C153/A21.53, "Ductile Iron Compact Fittings, 3 Inches through 24 Inches through 54 Inches through 64 Inches."

1. Working Pressures -- Fittings shall be suitable for the following working pressures unless otherwise noted:

<u>Sizes</u>	<u>Pressure Pounds per Square Inch Ductile Iron</u>
3" - 24"	350
30" - 48"	250

2. Coating and Lining -- The fittings shall be coated outside with a

bituminous coating in accordance with ANSI/AWWA C110/A21.10, "Ductile Iron and Gray Iron Fittings, 3 Inches through 48 Inches, for Water and Other Liquids," or ANSI/AWWA C153/21.53, "Ductile Iron Compact Fittings, 3 Inches through 24 Inches and 54 Inches through 64 Inches," and lined inside with cement mortar and seal coated in accordance with ANSI/AWWA C104/A21.4, "Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water."

3. All fittings shall be manufactured in the United States of America.

2.1.3 Joints

1. Push-on and Mechanical -- Push-on and mechanical joints including accessories shall conform to ANSI/AWWA C111/A21.11, "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings." Bolts shall be Cor-Ten steel tee head with hex nuts.
2. Flanged -- Flanged joints shall be used in underground installations except where specified.
 - a. Gaskets -- All flanged joints shall be furnished with 1/8 inch thick full face red rubber gaskets.
 - b. Bolts -- Bolts shall have American Standard heavy unfinished hexagonal head and nut dimensions, all as specified in ANSI B18.2.2, "Square and Hex Nuts Inch Series." For bolts 1-3/4 inches in diameter and larger, bolt studs with a nut on each end are recommended. Materials for bolts and nuts shall be Type 316 stainless steel.

3. Restrained

- a. Push-on -- Restrained push-on joints shall conform to ANSI/AWWA C11/A21.11, "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings." When bolts and nuts are required, they shall be Cor-Ten steel.
- b. Megalug restrained joints shall be installed where shown on the drawings.

2.1.4 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K, annealed. Joints for underground work shall be compression pattern, flared, for soft copper water tubing, and shall be made with approved fittings. Tubing shall be cut off square and expanded with a proper flaring tool.

2.1.5 Plastic Pipe and Fittings

PE Pipe -- PE pipe shall meet the requirements of ANSI/AWWA C 906, "Polyethylene (PE) Pressure Pipe, 4 inch through 63 inch for Water Distribution."

1. Dimensions -- Unless otherwise shown, the minimum thickness of the barrel of the pipe shall be Dimension Ratio (DR) 17.

Pipe Joints

1. Thermals Butt-Fusion -- All joints for PE pipe shall be of the thermal

butt-fusion.

2. Other -- Connections to pipe of different materials shall be made with adapters designed to join those materials.
3. Internal stainless steel stiffeners shall be used in the plain end of HDPE pipe when using mechanical couplings, push joint fittings, and mechanical joint fittings.

Thermal Fusion

1. Portable fusion equipment shall be used which holds the pipe in alignment while the opposing butt ends are faced, cleaned, melted, and fused together, and then cooled under fusion parameters recommended by the pipe and fusion equipment supplier. Portable fusion equipment manufactured specifically for PE pipe thermal butt-fusion shall be used. The Contractor shall be responsible for obtaining and adhering to the optimum fusion temperature, interface pressure, and cooling time as recommended by the pipe manufacturer.
2. Thermal fusion shall be conducted only by persons who have received training in the use of the fusion equipment according to the recommendations of the pipe supplier or the equipment supplier.

Fittings shall be ductile iron and shall conform to ANSI/AWWA C110/A21.10, "Ductile Iron and Gray Iron Fittings, 3 Inches through 48 Inches for Water and Other Liquids," or ANSI/AWWA C153/A21.53, "Ductile Iron Compact Fittings, 3 Inches through 24 Inches and 54 Inches through 64 Inches."

2.2 VALVES

2.2.1 Gate Valves

Water line valves shall be Resilient Wedge Gate Valve (RWGV) and meet the requirements of AWWA C509 latest edition, line valves shall be of full body design. Resilient Seat Compact-Type or Thin-Body Type valves are not acceptable. The RWGV shall be 250 PSIG working pressure and a 500 PSIG hydrostatic test pressure. The RWGV shall open "left" or "counterclockwise" and shall be supplied with a two inch square wrench nut. The RWGV shall have Type 316 stainless steel bolts and nuts for the stuffing box and bonnet. Resilient Wedge Gate Valves shall be Mueller A-2360-E30 open left and side tap valves T-2360-16E302 open left or approved equal.

2.2.2 Vacuum and Relief Valves

If required, vacuum and relief valves shall be size and type to relieve pressure and prevent the formation of a vacuum. Valves shall automatically remove air from the lines when the lines are being filled and admit air into the lines when water is being withdrawn in excess of the inflow.

2.2.3 Tapping Sleeves and Valves

Tapping sleeves and valves shall be designed for a working pressure of 250 psi for three inch through twelve inch and 150 psi for sixteen inch. The tapping sleeve together with the tapping valve shall be tested at 150 psi for visible leakage before the main is tapped.

Tapping Sleeves -- Tapping sleeves shall be two piece with either caulk

type or mechanical joint type ends, and be so designed as to assure uniform gasket pressure and permit centering of the sleeve on the pipe. Tapping sleeves shall have an iron body. Tapping sleeves shall be as manufactured by Mueller, Model No. H-615 for ductile iron, H-304 for PVC and HDPE, or approved equal by Engineer/Architect.

Tapping Valves -- Tapping valves shall have a flange on one end for bolting to the tapping sleeve and a mechanical joint type end connection on the outlet with slotted standard flange or other adapters for connection to the tapping machine. The valves shall open by turning clockwise. Tapping valves shall conform to AWWA C509 and Section 2.1.A except that the seat rings shall be oversized to permit entry of the tapping machine cutter. Valves shall be as manufactured Model No. A2361-16 for sixteen inch, or approved equal by Engineer/Architect.

2.2.4 Watch Valves

Watch valves shall meet requirements of AWWA C509 and shall open "left" or "counterclockwise."

2.3 MISCELLANEOUS ITEMS

2.3.1 Tapped Tees

Tees shall be installed as necessary.

2.3.2 Corporation Stops

Copper Tubing -- Corporation stops for use with copper tubing shall have an AWWA thread inlet with a copper service outlet and shall be Mueller H-15000, Hays 5200, or equal.

2.3.3 Service Clamps

Service clamps shall be used on HDPE water mains. Service clamps shall be designed for use with the specific type of main and have AWWA corporation stop threads. Service clamps shall be single strap. The clamps shall be equipped with an "O" ring seal cemented to the body of the clamp, marked with the size range on the saddle of the clamp, and shall be as manufactured by Mueller Co., Ford Meter Box Co., Clow Corporation, or equal.

2.3.4 Tubing

Copper Tubing -- Copper tubing shall be Type K, soft annealed tubing, conforming to ASTM B88, and rated at 200 pounds per square inch (psi) minimum working pressure.

A. Carrier Pipe -- Service located under pavement shall be installed in a 2 inch diameter schedule 40 rigid PVC conduit and be sunlight resistant gray or SDR7 polyethylene tubing.

B. Fittings -- All service connection fittings shall be compression type.

2.3.5 Connection to Main

Polyethylene (PE) -- The connection to a PE main shall be made by installing a service clamp and corporation stop.

Testing -- After a water service has been connected to the main, and before it is backfilled, the water service shall be tested by filling it with water under normal operating pressure of the main. The water service shall be observed and any leakage shall be eliminated prior to backfilling.

2.3.6 Service Boxes

Service boxes shall be cast iron. Extension service boxes of the required length, having either screw or slide adjustment, shall be installed at service-box locations. Boxes shall have housings of sufficient size to completely cover the service stop and shall be complete with identifying covers. Where water mains are located in streets having curbs, boxes shall be located directly back of the curbs. Where no curbing exists, boxes shall be in accessible locations beyond the limits of streets, walks, and driveways.

2.3.7 Valve Boxes

All valves shall be provided with valve boxes. Valve boxes shall be of standard, adjustable, heavy pattern, cast iron extension type, three pieces, 5-1/4 inch shaft, screw type, and of such length as necessary to extend from valve to finished grade. Tops shall be set at established grade, and the valve box cover marked "WATER." Five valve wrenches of sufficient length shall be provided.

Valve Size

Base

4" and smaller	Round, 8" in height, 10-7/8" diameter at bottom
6" and 8"	Round, 11" in height, 14-3/8" diameter at bottom
10" through 16"	Oval, 9-1/2" in height, 21" by 12-1/2" diameter at bottom
18" and 20"	Oval, 10" in height, 25-1/2" by 16" diameter at bottom
24"	Dome, 5" in height, 15" diameter, and 17" square flange at bottom

2.3.8 Valve Manholes

Valve manholes shall be constructed in accordance with the details indicated.

2.3.9 Fire Hydrants

Fire hydrants shall be Mueller Super Centurion A-423-250 or specified herein. Fire hydrants shall comply with AWWA C502 latest edition, Dry Barrel Fire hydrant. Hydrants shall be of compression-type with a five and on-quarter inch (5-1/4") valve opening, open left. The hydrant shoe shall be six inches (6") M.J. with all accessories. The complete interior of the shoe shall be coated with a H.P. epoxy. The main valve assembly shall consist of two (2) all bronze drain outlets, a bronze seat ring, a bronze drain ring, and a bronze top main valve plate or upper valve plate. The hydrant stem shall be made of steel rod, one and on-quarter inch (1-1/4") minimum diameter, except for machined surfaces. All hydrants shall be furnished with one (1) five inch (5") Storz nozzle, with 5-36 and two (2) two and one-half inch (2-1/2") N.S.T. hose nozzles. All hydrants shall be drainable. All hydrants shall be Type 316 stainless steel bolts and nuts below the bury line. M.J. shoe connection T-bolts shall be Cor-Ten steel. Unless otherwise specified, hydrants shall be buried a minimum of five feet (5'), and five feet (5') off edge of pavement.

Hydrant Wrench -- Five hydrant wrenches shall be provided.

Paint -- All hydrants shall be painted in accordance with the Owner' requirements. Contractor shall coordinated with the Owner prior to ordering the hydrants for the purpose of determining the required hydrant colors. Hydrants shall be painted using Rustoleum enamel paint, or equal. Contractor shall apply a final coat of the above specified paint after the hydrants are installed. The Contractor will supply the field applied paint.

2.4 CONCRETE

Concrete for thrust blocks shall be a minimum of 3,000 psi.

2.4 TRACER WIRE

Tracer wire shall be 12-gauge (minimum) copper single conductor wire with a minimum 30 MIL Polyethylene jacket designed for underground use and shall be continuous along the pipeline. The conductor shall be solid or stranded copper per ASTM B-1, B-3, or B-8.

PART 3 EXECUTION

3.1 PIPE HANDLING

Pipe and accessories shall be handled in a manner to ensure delivery to the trench in an undamaged condition. Particular care shall be taken not to injure the pipe coating. When the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in an approved manner. No other pipe or material shall be placed inside of a pipe or fitting after the coating has been applied. Pipe shall be carried into position. Use of pinch bars and tongs for aligning or turning the pipe shall be permitted only on the bare ends of the pipe. Interior of pipe and accessories shall be cleaned before being lowered into the trench and shall be kept clean during laying operations by an approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional cost to the Government. Rubber Gaskets that are not to be installed immediately shall be stored in a cool dark place out of the direct rays of the sun.

3.2 CUTTING OF PIPE

Cutting of pipe shall be done without damage to the pipe. Cutting shall be done with an approved mechanical cutter. Wheel cutters shall be used when practical. The cut end shall be smooth and at a right angle to the axis of the pipe. Cutting shall be performed without damage to the pipe or any lining or coating.

3.3 LOCATION

Where the location of the water pipe is not clearly defined by dimensions, the water pipe shall be laid not closer that 10 feet from a sewer horizontally. Water main shall cross gravity sanitary sewers with 18 inches of clearance minimum from outside to outside of pipes. Where waterlines cross under gravity flow sewer lines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be encased in concrete or shall be made of pressure pipe with no joint located within 3 feet, horizontally, of the crossing. Waterlines shall, in all cases, cross

above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main closer horizontally than 3 feet, to the crossing shall be encased in concrete. Waterlines shall not be laid in the same trench with gas lines, fuel lines, or electrical wiring.

3.4 DEFLECTION

Maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall be 5 degrees for cement or reinforced-concrete pipe. Maximum allowable deflection for cast-iron bell-and-spigot pipe and mechanical-joint pipe, shall be as recommended by the manufacturer.

When the alignment requires deflections in excess of the manufacturer's recommendations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth, as approved. Long-radius curves in reinforced-concrete pipe shall be formed by straight pipe in which spigot rings are placed on a bevel. Slight deflections may be made by straight pipe, provided that the maximum joint opening caused by such deflections does not exceed the maximum recommended by the pipe manufacturer. Short-radius curves and closures shall be formed by shorter lengths of pipe, bevels, or fabricated special sections.

3.5 PLACING, LAYING AND PIPE CONNECTIONS

Pipe and accessories shall be carefully lowered into the trench by suitable equipment. Under no circumstances shall materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers for removing skids across trenches shall be made of wood and have broad flat faces to prevent damage to the pipe or coating. Except where necessary in making connections with other lines or as authorized, pipe shall be laid with the bells facing upstream. Full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that foreign material will not enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor in an approved manner, at no additional expense to the Government.

Push-on Joints -- The surfaces with which the rubber gasket comes contact shall be thoroughly cleaned just prior to assembly. The gasket shall then be inserted into the groove in the bell. Before starting joint assembly, a liberal coating of special lubricant shall be applied to the spigot end. With the spigot and centered in the bell, the spigot end is pushed home.

Mechanical Joints -- Mechanical joints require that the spigot be centrally located in the bell. The surface with which the rubber gasket comes in contact shall be thoroughly cleaned just prior to assembly. These clean surfaces shall then be brushed with a special lubricant just prior slipping the gasket over the spigot end and into the bell. The lubricant shall also be brushed over the gasket prior to installation to remove the loose dirt and lubricate the gasket as it is forced into its retaining space.

Restrained Joints

- a. Push-on -- Assemble and install the push-on joint according to the manufacturer's recommendations. The joint shall be thoroughly cleaned and lubricated. Check the retainer ring fastener.
- b. Megalug -- Assemble and install Megalug restrained joints according to the manufacturer's recommendations.

Setting Valves -- Valves shall be set on a firm foundation so that no load will be transferred to the connecting pipe. Valves in water mains shall, where possible, be located on the street property lines extended, unless otherwise shown on the plans. A valve box shall be provided for every valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut on the valve. The box cover shall be set flush with the surface of the finished pavement unless otherwise shown.

Anchoring -- All plugs, caps, tees, and bends shall be provided with a concrete backing. If shown or specified, movement shall be prevented by attached suitable metal rods, clamps, or restraining fittings.

- a. Concrete Backing -- Concrete backing shall be 3,000 pounds per square inch concrete as specified in Section 03300, "Cast-In-Place Concrete." Backing shall be placed between undisturbed ground and the fitting and on the ground in each instance shall be that shown herein. The backing shall, unless otherwise shown, be so placed that the pipe and fitting joints will be accessible for repair.
- b. Tie Rods -- Steel tie rods or clamps, where permitted, shall be of adequate strength to prevent movement. Steel tie rods or clamps shall be painted with three coats of an approved bituminous paint or coal tar enamel.
- c. Restrained Fittings -- Restrained fittings, where permitted, shall be subject to the acceptance of the Owner.

Site Review -- Pipe and fittings will be reviewed by the Owner or his authorized representative immediately prior to installation and all rejected pieces must be completely removed from the project. Pipe acceptable to the Owner shall be substituted for rejected pieces at the Contractor's expense. No repairs of pipe or fittings will be allowed; undamaged lengths of straight pipe may be salvaged by neatly sawing off the damaged portion of the pipe.

Manufacturer -- The manufacturer of the HDPE pipe furnished shall provide installation instruction and literature to the Contractor so that he will be aware of the manufacturer's recommended procedure and practice of installing pipe and fittings. This instruction shall be included at no addition cost to the Owner.

Connections -- Connections to pipe of different materials shall be made with the proper adapters.

Pipe ends left for future connections shall be valved, plugged, or capped and anchored. Where connections are made between new work and existing mains, the connections shall be made by using special sections and fittings to suit the actual conditions. Where made under pressure, connections shall be installed in accordance with the recommendations of the manufacturer of the pipe being tapped.

3.6 DIRECTIONAL DRILLING INSTALLATION FOR POLYETHYLENE MAINS

Direction drilling shall include all work necessary for the installation of high density polyethylene (HDPE) pipes. Provide services in accordance with the best industry practice and these specifications. Furnish all labor, equipment, and materials necessary to accomplish the work.

At all times, Contractor shall provide and maintain instrumentation which will accurately locate the pilot hole and measure drilling fluid flow discharge rate and pressure. Provide hydraulic pressure regulations of load sensors between pulling equipment and pipe. Owner shall have access to instruments, gages, and ratings at all times. Provide "as-built" data including horizontal and vertical location of pipe line at 50-foot intervals.

Prior to commencing directional drilling, submit details of equipment and detailed working drawings describing the proposed method of directional drilling. This shall include arrangement of equipment, location, and size of drilling and receiving pits, method of dewatering, method of removing spoils materials, size and capacity of equipment, method of installing carrier pipe, method of fusing pipe segments, type of cutting heated, method of installation detection wire, carrier pipe end seals, support segments, method of monitoring and controlling line and grade, and method of abandonment of pilot hole. Sufficient material shall be submitted to show compliance with the Contract Documents and to show that articles proposed for use in the work are acceptable.

All drawings, catalog cuts, and other descriptive data covering several related items in the same system shall be submitted at the time in order that their complete integrated applicability in the entire system be adequately reviewed.

Bentonite/drilling mud; product information, material specifications, handling procedures, special precautions required, and method of mixing and installation.

Drilling Fluids -- Provide drilling fluid meeting all environmental regulations which provide lubrication to the pipe, annular flushing of the bore hole, and stability and support to the bored hole.

Contractor shall maintain directional tolerances as called for in these specifications. Drill pilot hole along the path shown on the plan and profile drawing to the following tolerances:

1. Horizontal Alignment -- Plus or minus 6 inches.
2. Curve Radius -- Contractor shall confirm radius curvatures required to accomplish the installation prior to initiation of work.
3. Provide drilling fluid relief holes every 50 feet and immediately outside of the pavement area on both sides when crossing roadways.

Prereaming -- Prereaming operations shall be conducted at the discretion of the horizontal drilling contractor. All provisions of this specification relating to the simultaneous reaming and pulling back operations shall also pertain to prereaming operations.

Pulling Loads -- The maximum allowable tensile load imposed on the pipeline

pull section shall not exceed that recommended by pipe manufacturer.

Torsional Stress -- Provide a swivel to connect the pull section to the reaming assembly to minimize torsional stress imposed on the section.

Pull Section Support -- Support the pull section as it proceeds during pull back so that it moves freely.

Pull two tracing wires along with the carrier pipe.

Pull back in one continuous operation. Notify Owner of any pull back which is resumed.

Disposal -- All drilling fluids shall be disposed of by the Contractor. Disposal of drilling fluids shall be in compliance with all relative environmental regulations. Provide drilling fluid relief holes every 200 feet and immediately outside of pavement area on both sides when crossing roadways.

Inadvertent Returns -- Minimize drilling fluid returns at locations other than the entry and exit points. Clean up any inadvertent returns.

After installation of the water main is complete, restore drilling and receiving pits to equal or better condition than originally found.

3.7 COUPLINGS AND JOINTS

Joints for Copper Tubing shall be compression pattern, flared, for soft copper water tubing and shall be made of approved fittings. Tubing shall be cut off square and expanded with an acceptable flaring tool. Installation of couplings and mechanical joints shall be in accordance with the manufacturer's recommendations. Pipe Connections between different types of pipe and accessories shall be made with transition fittings as recommended by the manufacturer.

3.8 SERVICE LINES

Service lines shall include the lines to and connections with, the building service at a point 5 feet outside the building. Where building services are not installed, the Contractor shall terminate the service lines 5 feet from the site of the proposed building at the point designated. Such service lines shall be closed with plugs or caps. Service Stops and Gate Valves shall be provided with extension boxes of the lengths required by the depths of service line stops or valves. Service lines shall be constructed in accordance with the following: service lines 1-1/2 inches and smaller shall be connected to the main by a Corporation-Type Stops and a copper gooseneck, with a service stop below the frostline. Two-inch service lines shall be connected to the main with a rigid connection or a corporation-type stop and copper gooseneck and a gate valve located below the frostline. Where two or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard quality branch connections in conformance with recognized standard practice. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply. Service lines larger than 2 inches shall be connected to the main by a rigid connection and shall have a gate valve located below the frostline.

3.9 FIRE HYDRANTS, VALVES, AND VALVE BOXES

Hydrants and valves shall have the interiors cleaned of all foreign matter before installation. Each hydrant shall be connected to the main with a 6-inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with the pumper nozzle facing the roadway, the center of the lowest outlet not less than 18 inches above the finished surrounding grade, and the operating nut not more than 4-feet above the finished grade. At least 7 cubic feet of broken stone shall be placed around the base of the hydrant to ensure drainage. Backfill around the hydrant shall be compacted to the finished gradeline immediately after installation to obtain beneficial use of the hydrant as soon as practicable. Hydrant shall be set on a slab of concrete not less than 4 inches thick and 15 inches square. Valves and valve boxes shall be set plumb. Valve boxes shall be centered on the valves. Valves shall be located outside the area of sidewalks, roads, streets, and parking areas. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box or to the undisturbed trench face if less than 4 feet. Stuffing boxes shall be tightened, and the hydrants and valves shall be inspected in open and closed positions to ensure that all parts are in working condition.

3.10 TAPPING SLEEVES AND VALVES

The Contractor shall provide all materials and install the tapping sleeve and valve on the water main to be tapped. The County will perform an air test on the sleeve and valve. After passing the air test, the County will perform the tap. If the air test fails, the Contractor shall reinstall tapping sleeve and valve until the air test is passed. The Contractor shall be responsible for all other costs prior to and after the tap is performed.

3.11 THRUST BLOCKS

Plugs, caps, tees, bends deflecting 22-1/2 degrees or more on mains 8 inches in diameter or larger, and fire hydrants shall be provided with concrete thrust blocks. Blocks shall be placed between solid ground and the hydrant or fitting to be anchored. Blocks shall be so placed that fitting joints will be accessible for repair.

3.12 TESTING

3.12.1 Hydrostatic Test

Hydrostatic-pressure test shall be made no sooner than 72 hours after installation of thrust blocks.

3.12.2 Pressure Test

After the pipe is laid, the joints completed, the fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall be subjected for 1 hour to a hydrostatic-pressure test of 200 psi. Mains supplying water to individual buildings for fire protection shall be subjected for 2 hours to a hydrostatic-pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, valves, and hydrants shall be carefully examined during the open-trench test. Joints showing visible leakage shall be replaced or remade as necessary. Leaking rubber gasketed joints shall be

remade using new gaskets when necessary. Pipe, mechanical joints, fittings, valves, or hydrants discovered to be cracked or defective as a consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are approved.

3.12.3 Leakage Test

Leakage tests shall be conducted after the pressure test has been approved. Duration of each leakage test shall be at least 2 hours. During the test, the main shall be subjected to a pressure of 200 psi. Leakage is defined as the additional quantity of water supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

Allowable leakage in gallons per hour per joint at 200 psi average test pressure shall be as follows:

<u>PIPE DIAMETER (INCHES)</u>	<u>ALLOWABLE LEAKAGE (GALLONS PER HOUR)</u>
2	0.0153
3	0.0230
4	0.0306
6	0.0458
8	0.0610
10	0.0765
12	0.0915
14	0.1070
16	0.1225
18	0.1375
20	0.1530
24	0.1830

Should any test of laid pipe disclose a leakage greater than that shown, the defective joints shall be located and repaired until the leakage is within the specified tolerance, at no additional cost to the Government.

3.12.4 Test Timing

Except where concrete-reaction backing necessitates a 72-hour delay, pipelines jointed with rubber gaskets, mechanical, or bolted joints may be subjected to hydrostatic pressure, inspected, and tested for leakage after partial completion of backfill.

3.12.5 Retesting

Before permanent paving is placed over the pipeline, a measured leakage test of the entire pipeline shall be required. Leakage loss shall be within approved tolerances.

3.12.6 Sterilizing

After pressure tests have been completed and before introducing the sterilizing solution, piping to be sterilized shall be flushed with water, for a period of time as designated by the COTR, to remove any entrained dirt.

Water piping, including valves, fittings, and other devices, shall be sterilized and tested according to AWWA C651. After successful sterilization, the piping shall be flushed before placing into service. Water for sterilization will be furnished by the Government, but disposal shall be the responsibility of the Contractor.

3.12.7 Tracer Wire

Tracer wire shall be installed on all new underground piping except ductile iron pipe. The wire shall be installed in such a manner as to be able to properly trace all services without loss or deterioration of signal or without transmitted signal migrating off the tracer wire.

Tracer wire shall be laid flat and securely affixed to the pipe at 10-foot intervals. The wire shall be protected from damage during the execution of work. No breaks or cuts in the tracer wire shall be permitted. The tracer wire shall not be placed between the saddle and the main.

Where a valve box is used, the tracer wire from both directions shall be secured every 20 inches to the outside of the valve box and be brought up on the outside of the valve box to a point 6 inches below grade, then the tracer wire brought into the valve box and left with 18 inches of slack.

Between valve box locations in 500-foot intervals, the tracer wire from both directions shall be secured to an identification post and brought up on the identification post to terminals for wire tracing. The post shall be clearly labeled for the intended service and be at a height of 4 feet above grade.

All spliced or repaired tracer wire shall be made using a split bolt or compression type connector for two to four #12 wires or approved equivalent and made waterproof using an approved buried service wire closure.

Contractor shall demonstrate that the tracer wire is installed and functioning properly. If deficiencies are found, the contractor shall be responsible for all subsequent visits to the site to repair and confirm functionality at no additional cost to the government.

-- End of Section --

SECTION 02718

UNDERGROUND WATER SUPPLY SYSTEMS

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES

ASME INTERNATIONAL (ASME)

ASME B16.1 (1998) Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

ASTM INTERNATIONAL (ASTM)

ASTM B 43 (1998e1) Standard Specification for Seamless Red Brass Pipe, Standard Sizes

ASTM B 88 (2003) Standard Specification for Seamless Copper Water Tube

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104 (1990; 1st Ed) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C105 (1999) Polyethylene Encasement for Ductile-Iron Pipe Systems

AWWA C110 (1998) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (76 mm through 1219 mm), for Water Erratum: October 1999

AWWA C111 (2000) Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C151 (2002) Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids

AWWA C203 (2002) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied

AWWA C205 (2000) Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. and Larger - Shop Applied

AWWA C209 (2000) Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines

AWWA C500 (2002; Addendum C500A - 1995) Metal Seated Gate Valves for Water Supply Service

FEDERAL SPECIFICATIONS (FS)

FS BB-C-120 (Rev C) Chlorine, Technical, Liquid
 FS O-C-114 (Rev B; Am 2) Calcium Hypochlorite,
 Technical
 FS O-S-602 (Rev. E) Sodium Hypochlorite Solution

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND
 FITTINGS INDUSTRY (MSS)

MSS SP-80 (2003) Bronze Gate, Globe, Angle and Check
 Valves

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300,
 "Submittals":

SD-01, Data

Manufacturer's Catalog Data

SD-04, Drawings

As-Built Drawings

PART 2 PRODUCTS

2.1 PIPING

2.1.1 Cast-Iron/Ductile-Iron Pipe

Ductile-iron pipe shall be as specified in AWWA C151, Class 52, with push-on or mechanical joints and cement-mortar lining conforming to AWWA C104 or AWWA C205. Thrust blocks shall be installed except when mechanical joints have retaining glands.

Polyethylene encasement shall be as specified in AWWA C105 and be installed over all underground pipe and fittings.

Cast-iron fittings shall be in accordance with AWWA C110.

Cast-iron pipe flanges and flanged fittings shall conform to ASME B16.1.

Coal-tar protective coating shall conform to AWWA C203 and furnished on exterior of all pipe and fittings.

Cold-applied tape coating of fittings shall be in accordance with AWWA C209.

2.1.2 Pipe Connections

Bolts, nuts, and washers shall conform to the recommendations of the pipe manufacturer.

2.1.3 Rubber Gaskets

Rubber-gasket joints for cast-iron pipe, gaskets, and lubricant shall

conform to the applicable requirements of AWWA C111. For asbestos-cement and steel pipe, the gaskets shall be in accordance with recommendations of the pipe manufacturer. Joints shall be so designed that, when the pipe is laid and the joint completed, the gasket will be completely enclosed. Rubber gaskets shall be the sole element depended upon for watertightness. Gaskets shall be continuous rings of the necessary size and cross section to fill the recess provided and shall conform to the recommendations of the pipe manufacturer, as applicable.

2.1.4 Copper Pipe

Type K soft drawn copper pipe shall be used for 2-inch and smaller water lines. Pipe shall conform to ASTM B 88 with solder joint fittings. Solder shall be 95-percent tin and 5-percent antimony or other NO LEADsolder as approved by the C.O.R.. Fittings shall be of cast brass conforming to ASTM B 43.

2.2 VALVES

2.2.1 Gate Valves

Valves shall be designed for a minimum of 150 psi. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. Valves smaller than 3 inches shall be all brass and shall conform to MSS SP-80, Type I. Valves 3 inches and larger shall be iron-body, brass-mounted, conforming to AWWA C500 and flanged construction for 12 inches and larger.

2.3 MISCELLANEOUS ITEMS

2.3.1 Tapped Tees

Tees shall be installed where indicated or directed.

2.3.2 Corporation Stops

Corporation stops shall have waterworks standard thread on the inlet end, with flanged-joint couplings or wiped joints for connections to goosenecks.

2.3.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed.

2.3.4 Service Stops

Service stops shall be waterworks ground-key type, oval flowway, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. Parts shall be cast red brass having a nominal composition of 85 percent copper, 5 percent tin, 5 percent lead, and 5 percent zinc, with female iron-pipe-size connections designed for a minimum pressure of 200 psi.

2.3.5 Valve Boxes

Valve boxes shall be cast iron or concrete, complete with lock-type covers requiring a special wrench for removal. Cast-iron boxes shall be the extension type with screw or slide adjustments and with flared bases. Concrete boxes shall be constructed in accordance with details indicated.

The letter "W" shall be cast in the cover. Boxes shall be installed over each gate valve. Boxes shall be of such a length as can be adapted, without full extension, to the depth of cover required over the pipe at the valve location. Concrete boxes may be installed only in locations not subjected to vehicular traffic. Valve wrenches shall be furnished for each valve.

2.3.6 Fire Hydrants

Fire hydrants shall be Mueller Super Centurion A-423 type with STORZ pumper nozzle option, as specified. Hydrants shall have a 6-inch bell connection, two 2-1/2-inch hose connections, and one 4-1/2-inch pumper connection. Outlets shall have American National fire-hose coupling threads. Working parts shall be bronze. Hydrants shall be connected to the mains with 6-inch diameter pipes. Design, material, and workmanship shall be similar and equal to the latest stock pattern ordinarily produced by the manufacturer. Hydrants shall be painted with one coat of zinc-chromate alkyd paint primer and two finish coats of approved paint with green top and nozzle cap.

PART 3 EXECUTION

3.1 PIPE HANDLING

Pipe and accessories shall be handled in a manner to ensure delivery to the trench in an undamaged condition. Particular care shall be taken not to injure the pipe coating. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in an approved manner. No other pipe or material shall be placed inside of a pipe or fitting after the coating has been applied. Pipe shall be carried, not dragged, into position. Use of pinch bars and tongs for aligning or turning the pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be cleaned before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects and shall be tapped with a light hammer to detect cracks. Material found to be defective before or after laying shall be replaced with sound material without additional cost to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool dark place out of the direct rays of the sun.

3.2 CUTTING OF PIPE

Cutting of pipe shall be done without damage to the pipe. Unless otherwise authorized or recommended by the manufacturer, cutting shall be done with an approved mechanical cutter. Wheel cutters shall be used when practical.

3.3 LOCATION

Where the location of the water pipe is not clearly defined by dimensions, the water pipe shall be laid not closer than 10 feet from a sewer horizontally, except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall be laid not closer than 6 feet from the sewer horizontally. Where waterlines cross under gravity flow sewer lines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet, horizontally, of the crossing. Waterlines shall, in all cases, cross above sewage force mains or inverted siphons and shall be not

less than 2 feet above the sewer main. Joints in the sewer main closer horizontally than 3 feet to the crossing shall be encased in concrete. Waterlines shall not be laid in the same trench with gas lines, fuel lines, or electrical wiring.

3.4 DEFLECTION

Maximum allowable deflections for cast-iron bell and spigot pipe from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall be as recommended by the manufacturer.

If the alignment requires deflections in excess of the manufacturer's recommendations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth, as approved. Long-radius curves in reinforced-concrete pipe shall be formed by straight pipe in which spigot rings are placed on a bevel. Slight deflections may be made by straight pipe, provided that the maximum joint opening caused by such deflections does not exceed the maximum recommended by the pipe manufacturer. Short-radius curves and closures shall be formed by shorter lengths of pipe, bevels, or fabricated special sections as specified.

3.5 PLACING AND LAYING

Pipe and accessories shall be carefully lowered into the trench by means of derricks, ropes, belt slings, or other suitable equipment. Under no circumstances shall materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers for removing skids across trenches shall be of wood and have broad flat faces to prevent damage to the pipe or coating. Except where necessary in making connections with other lines or as authorized, pipe shall be laid with the bells facing upstream. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that vermin, water, earth, or other substance will not enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense and in an approved manner.

3.6 RUBBER GASKETS

Rubber gaskets shall be handled, lubricated, and installed in accordance with the recommendations of the pipe manufacturer. Outside annular space between abutting sections of concrete pipe shall be filled with rich cement mortar. When recommended by the manufacturer, the inside annular joint space shall be filled with rich cement mortar after backfilling has been at least partially accomplished.

3.7 COUPLINGS AND JOINTS

Joints for copper tubing shall be compression pattern, flared, for soft copper water tubing and shall be made of fittings meeting approved standards. Tubing shall be cut off square and expanded with an acceptable flaring tool. Installation of mechanical joints shall be in accordance with the recommendations of the manufacturer. Connections between different types of pipe and accessories shall be made with transition

fittings as recommended by the manufacturer.

3.8 SERVICE LINES

Service lines shall include the lines to and connections with, the building service at a point approximately 5 feet outside the building. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated. Such service lines shall be closed with plugs or caps. Service stops and gate valves shall be provided with extension boxes of the lengths required by the depths of service line stops or valves. Service lines shall be constructed in accordance with the following requirements: service lines 1-1/2 inches and smaller shall be connected to the main by a corporation-type stop and a copper gooseneck, with a service stop below the frostline. Two-inch service lines shall be connected to the main with a rigid connection or a corporation-type stop and copper gooseneck and a gate valve located below the frostline. Where two or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard quality branch connections in conformance with recognized standard practice. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply. Service lines 3-inches and larger shall be connected to the main by a rigid connection and shall have a gate valve located below the frostline.

3.9 FIRE HYDRANTS, VALVES, AND VALVE BOXES

Fire hydrants shall be located and installed as indicated. Hydrants and valves shall have the interiors cleaned of all foreign matter before installation. Each hydrant shall be connected to the main with a 6-inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with the pumper nozzle facing the roadway, the center of the lowest outlet not less than 18 inches above the finished surrounding grade, and the operating nut not more than 4 feet above the finished grade. Except where approved otherwise, not less than 7 cubic feet of broken stone shall be placed around the base of the hydrant to ensure drainage. Backfill around the hydrant shall be compacted to the finished gradeline immediately after installation to obtain beneficial use of the hydrant as soon as practical. Hydrant shall be set upon a slab of concrete not less than 4 inches thick and 15 inches square. Valves and valve boxes shall be installed where indicated or directed and shall be set plumb. Valve boxes shall be centered on the valves. Valves shall be located outside the area of sidewalks, roads, streets, and parking areas. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box or to the undisturbed trench face if less than 4 feet. Stuffing boxes shall be tightened, and the hydrants and valves shall be inspected in open and closed positions to ensure that all parts are in working condition.

3.10 THRUST BLOCKS

Plugs, caps, tees, bends deflecting 22-1/2 degrees or more on mains 8 inches in diameter or larger, and fire hydrants shall be provided with concrete thrust blocks. Blocks shall be concrete of a mix not leaner than 1 part cement to 2-1/2 parts sand to 5 parts gravel. Blocks shall be placed between solid ground and the hydrant or fitting to be anchored. The area of bearing shall be as indicated or as directed. Unless otherwise indicated or directed, blocks shall be so placed that fitting joints will be accessible for repair.

3.11 TESTING

3.11.1 Hydrostatic Tests

Hydrostatic-pressure test shall be made no sooner than 72 hours after installation of thrust blocks, unless otherwise approved.

3.11.2 Pressure Tests

After the pipe is laid, the joints completed, the fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic-pressure test of 200 psi. Mains supplying water to individual buildings for fire protection shall be subjected for 2 hours to a hydrostatic-pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, valves, and hydrants shall be carefully examined during the open-trench test. Joints showing visible leakage shall be replaced or remade as necessary. Leaking rubber gasketed joints shall be remade using new gaskets if necessary. Pipe, mechanical joints, fittings, valves, or hydrants discovered to be cracked or defective as a consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are approved.

3.11.3 Leakage Tests

Leakage tests shall be conducted after the pressure test has been approved. The duration of each leakage test shall be at least 2 hours. During the test, the main shall be subjected to a pressure of 200 psi. Leakage is defined as the additional quantity of water supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula $L = 0.00054ND \sqrt{P}$ in which L equals the allowable leakage in gallons per hour, N is the number of joints in the length of pipeline tested, D is the nominal diameter of the pipe in inches, and P is the average test pressure in psi during the leakage test. Allowable leakage in gallons per hour per joint at 200 psi average test pressure shall be as follows:

<u>PIPE DIAMETER (INCHES)</u>	<u>ALLOWABLE LEAKAGE (GALLONS PER HOUR)</u>
2 (and smaller)	0.0153
3	0.0230
4	0.0306
6	0.0458
8	0.0610
10	0.0765

<u>PIPE DIAMETER (INCHES)</u>	<u>ALLOWABLE LEAKAGE (GALLONS PER HOUR)</u>
12	0.0915
14	0.1070
16	0.1225
18	0.1375
20	0.1530
24	0.1830

Should any test of laid pipe disclose a leakage greater than that specified herein, the defective joints shall be located and repaired until the leakage is within the specified allowance, at no additional cost to the Government.

3.11.4 Test Timing

Except where concrete-reaction backing necessitates a 72-hour delay, pipelines jointed with rubber gaskets, mechanical, or bolted joints may be subjected to hydrostatic pressure, inspected, and tested for leakage after partial completion of backfill. Asbestos-cement pipe and concrete pipe shall be filled with water for at least 24 hours before being subjected to the pressure test and subsequent leakage test.

3.11.5 Retesting

Before permanent paving is placed over the pipeline, a measured leakage test of the entire pipeline may be required at the option of the Contracting Officer. Leakage loss shall be within the allowances specified.

3.12 STERILIZATION

After pressure tests have been completed and before introducing the sterilizing solution, piping to be sterilized shall be flushed with water, for a period of time as designated by the COTR, to remove any entrained dirt.

All potable water piping, including valves, fittings, and other devices, shall be sterilized with a solution of chlorine and water. The chlorinating material shall be liquid chlorine conforming to FS BB-C-120, calcium hypochlorite conforming to FS O-C-114, Table I, or sodium hypochlorite conforming to FS O-S-602, Grade A or B. The chlorinating material shall provide a dosage of not less than 50 parts per million (ppm) introduced into the piping in a manner approved by the COTR. Treated water shall be retained in the piping for a period of not less than 8 hours to destroy all non-spore-forming bacteria. After the specified minimum time, the solution shall contain not less than 10 ppm of available chlorine or piping shall be reesterilized. If the solution contains more than 10 ppm of chlorine, samples of water shall be taken for a bacteria count. The samples of water shall be sent to an independent testing lab for the count in accordance with EPA 40CFR, Chapter 1, Section 141.14. "Maximum microbiological contaminant level" and the results submitted to the COTR for approval. System shall be reesterilized until the count is approved. Water for sterilization will be furnished by the Government, but disposal

of contaminated water shall be the responsibility of the Contractor.

Upon completion and approval of sterilization and before placing the system into service, the piping shall be flushed with water for a minimum of 2 hours or until the residual chlorine is reduced to less than 1.0 ppm.

-- End of Section --

SECTION 02742

HOT MIX BITUMINOUS PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

The work under this section shall include all labor, services, equipment, materials and tools necessary to install bituminous asphalt concrete pavement according to the Contract drawings and as specified herein. The work includes preparing the subgrade surface, installing an aggregate base course, a bituminous aggregate base course, a bituminous aggregate intermediate course, an asphalt concrete wearing course, and joints abutting other construction.

The bituminous asphalt pavement shall be installed in the full depth replacement areas and in the new pavement areas as shown on the Contract drawings and pavement markings shall be restored.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the xbasic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 127	(2004) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128	(2004a) Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 131	(2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 188	(1995; R 2003) Density of Hydraulic Cement
ASTM C 88	(2005) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 1188	(1996; R 2002) Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2041	(2003a) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2726	(2004) Bulk Specific Gravity and Density

	of Non-Absorptive Compacted Bituminous Mixtures
ASTM D 4867/D 4867M	(2004) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 70	(2003) Specific Gravity and Density of Semi-Solid Bituminous Materials (Pycnometer Method)
ASTM D 854	(2002) Specific Gravity of Soil Solids by Water Pycnometer

STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

ODOT 301	(2002) Bituminous Aggregate Base; and Subparts as Specified
ODOT 304	(2002) Aggregate Base; and Subparts as Specified
ODOT 401	(2002) Asphalt Concrete Pavements-General; and Subparts as Specified
ODOT 448	(2002) Asphalt Concrete; and Subparts as Specified
ODOT 407	(2002) Tack Coat; and Subparts as Specified
ODOT 408	(2002) Prime Coat; and Subparts as Specified
ODOT 705	(2002) Concrete Pavement Incidentals; and Subparts as Specified

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction Equipment List for all major pieces of equipment to be used to execute this specification shall be submitted by the Contractor.

SD-05 Design Data

Mix Designs for each bituminous concrete mixture shall be submitted for approval for each type of bituminous material specified. Compliance with ODOT material specifications is mandatory.

SD-06 Test Reports

Specific gravity test of asphalt

Coarse aggregate tests

Percent of crushed pieces in gravel

Fine aggregate tests

Bituminous mixture tests

Aggregates tests

Bituminous mix tests

Pavement courses

SD-07 Certificates

Certificates of Compliance for the following items shall be submitted in accordance with the applicable reference standards and specifications contained within this section:

Coarse Aggregate Mineralogy and Gradation

Fine Aggregate Mineralogy and Gradation

Asphalt Cement

1.4 ENVIRONMENTAL CONDITIONS

Place bituminous mixture only during dry weather and on dry surfaces. Place courses only when the surface temperature of the underlying course is greater than 45 degrees F for course thicknesses two inch or greater and 55 degrees F for course thicknesses less than two inch.

1.5 CONSTRUCTION EQUIPMENT

Calibrated equipment, such as scales, batching equipment, spreaders and similar equipment, shall have been recalibrated by a calibration laboratory approved by the Contracting Officer within 6 months of commencing work.

1.5.1 Paving Equipment

1.5.1.1 Spreading Equipment

Self-propelled electronically controlled type, unless other equipment is authorized by the Contracting Officer. Equip spreading equipment of the self-propelled electronically controlled type with hoppers, tamping or vibrating devices, distributing screws, electronically adjustable screeds, and equalizing devices. Capable of spreading hot bituminous mixtures without tearing, shoving, or gouging and to produce a finished surface of specified grade and smoothness. Operate spreaders, when laying mixture, at variable speeds between 5 and 45 feet per minute. Design spreader with a quick and efficient steering device; a forward and reverse traveling speed; and automatic devices to adjust to grade and confine the edges of the mixture to true lines. The use of a spreader that leaves indented areas or other objectionable irregularities in the fresh laid mix during operations is prohibited.

1.5.1.2 Rolling Equipment

Self-propelled pneumatic-tired rollers supplemented by three-wheel and tandem type steel wheel rollers. The number, type and weight of rollers

shall be sufficient to compact the mixture to the required density without detrimentally affecting the compacted material. Rollers shall be suitable for rolling hot-mix bituminous pavements and capable of reversing without backlash. Pneumatic-tired rollers shall be capable of being operated both forward and backward without turning on the mat, and without loosening the surface being rolled. Equip rollers with suitable devices and apparatus to keep the rolling surfaces wet and prevent adherence of bituminous mixture. Vibratory rollers especially designed for bituminous concrete compaction may be used provided rollers do not impair stability of pavement structure and underlying layers. Repair depressions in pavement surfaces resulting from use of vibratory rollers. Rollers shall be self-propelled, single or dual vibrating drums, and steel drive wheels, as applicable; equipped with variable amplitude and separate controls for energy and propulsion.

1.5.1.3 Mechanical Hand Tampers

Commercial type, operated by pneumatic pressure or by internal combustion.

PART 2 PRODUCTS

2.1 AGGREGATE BASE

The aggregate base shall consist of ODOT 304 aggregate base except that aggregate shall only consist of limestone or dolomite. Slag shall not be permitted for any purpose. All other requirements apply. Thickness shall be as shown on the Contract drawings.

2.1.1 BITUMINOUS AGGREGATE BASE

The bituminous aggregate base course shall consist of ODOT 301 bituminous aggregate base. All requirements found in ODOT 408 apply except that the aggregate shall consist only of limestone or dolomite. Slag shall not be permitted for any purpose. Thickness shall be as shown on the Contract drawings.

2.1.2 INTERMEDIATE COURSE

The intermediate course shall consist of ODOT 448 asphalt concrete. All requirements found in ODOT 401 apply except that the aggregate shall consist only of limestone or dolomite. Slag shall not be permitted for any purpose. Thickness shall be as shown on the Contract drawings.

2.1.3 WEARING COURSE

The wearing course shall consist of ODOT 448 asphalt concrete. All requirements found in ODOT 401 apply except that the aggregate shall consist only of limestone or dolomite. Slag shall not be permitted for any purpose. Thickness shall be as shown on the Contract drawings.

2.1.4 TACK COAT

The bituminous tack coat shall be rapid curing cut-back asphalt conforming to designation RC-70, as specified in ODOT 407.

2.1.5 JOINT SEALANT

The bituminous joint sealant shall be ODOT 705.04 hot-applied crack and joint sealer.

2.7 PRIME COAT

The bituminous prime coat shall comply with the requirements of ODOT 408, except that cover aggregate, where specified on the contract drawings, shall not be slag.

2.8 SOURCE QUALITY CONTROL

Employ a commercial laboratory approved by the Contracting Officer to perform testing. The laboratory used to develop the JMF and the laboratory used to perform all sampling and testing shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The certification shall contain as a minimum:

- a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.
- b. A listing of equipment to be used in developing the job mix.
- c. A copy of the laboratory's quality control system.
- d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

2.2 Tests

Perform testing in accordance with the following:

- a. Specific Gravity Test of Asphalt: ASTM D 70
- b. Coarse Aggregate Tests:
 - (1) Bulk Specific Gravity: ASTM C 127
 - (2) Abrasion Loss: ASTM C 131
 - (3) Soundness Loss: ASTM C 88
- d. Percent of Crushed Pieces in Gravel: Count by observation and weight
- e. Fine Aggregate Tests:
 - (1) Bulk Specific Gravity: ASTM C 128
 - (2) Soundness Loss: ASTM C 88
- f. Specific Gravity of Mineral Filler: ASTM C 188 or ASTM D 854
- g. Bituminous Mixture Tests:
 - (1) Bulk Specific Gravity: ASTM D 1188 or ASTM D 2726
 - (2) Theoretical Maximum Specific Gravity: ASTM D 2041
 - (3) Tensile Strength Ratio: ASTM D 4867/D 4867M

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Preparation of Asphalt Binder Material

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 160 degrees C 325 degrees F when added to the aggregates. Modified asphalts shall be no more than 174 degrees C 350 degrees F when added to the aggregate.

3.1.3 Spraying of Contact Surfaces

Spray contact surfaces of previously constructed pavement with a thin coat of bituminous materials to act as an anti-stripping agent, Paint contact surfaces of structures with a thin coat of emulsion or other approved bituminous material prior to placing the bituminous mixture. Tack coat the previously placed primed coats on base courses when surface has become excessively dirty and cannot be cleaned or when primed surface has cured to the extent that it has lost all bonding effect.

3.2 PLACEMENT

3.2.1 Machine Spreading

The range of temperatures of the mixtures at the time of spreading shall be between 250 degrees F and 300 degrees F. Bituminous concrete having temperatures less than minimum spreading temperature when dumped into the spreader will be rejected. Adjust spreader and regulate speed so that the surface of the course is smooth and continuous without tears and pulling, and of such depth that, when compacted, the surface conforms with the cross section, grade, and contour indicated. Construct longitudinal joints and edges to true line markings. Establish lines parallel to the centerline of the area to be paved, and place string lines coinciding with the established lines for the spreading machine to follow.

3.2.2 Shoveling, Raking, and Tamping After Machine-Spreading

Shovelers and rakers shall follow the spreading machine. Add or remove hot mixture and rake the mixture as required to obtain a course that when completed will conform to requirements specified herein. Broadcasting or fanning of mixture over areas being compacted is prohibited. When segregation occurs in the mixture during placing, suspend spreading operation until the cause is determined and corrected. Correct irregularities in alinement left by the spreader by trimming directly behind the machine. Immediately after trimming, compact edges of the course by tamping laterally with a metal lute or by other approved methods. Distortion of the course during tamping is prohibited.

3.2.3 Hand-Spreading in Lieu of Machine-Spreading

In areas where the use of machine spreading is impractical, spread mixture by hand. The range of temperatures of the mixtures when dumped onto the area to be paved shall be between 250 and 300 degrees F. Mixtures having temperatures less than minimum spreading temperature when dumped onto the area to be paved will be rejected. Spread hot mixture with rakes in a uniformly loose layer of a thickness that, when compacted, will conform to

the required grade, thickness, and smoothness. During hand spreading, place each shovelful of mixture by turning the shovel over in a manner that will prevent segregation. Do not place mixture by throwing or broadcasting from a shovel. Do not dump loads any faster than can be properly handled by the shovelers and rakers.

3.3 COMPACTION OF MIXTURE

Compact mixture by rolling. Begin rolling as soon as placement of mixture will bear rollers. Delays in rolling freshly spread mixture shall not be permitted. Start rolling longitudinally at the extreme sides of the lanes and proceed toward center of pavement, or toward high side of pavement with a one-way slope. Operate rollers so that each trip overlaps the previous adjacent strip by at least one foot. Alternate trips of the roller shall be of slightly different lengths. Conduct tests for conformity with the specified crown, grade and smoothness immediately after initial rolling. Before continuing rolling, correct variations by removing or adding materials as necessary. If required, subject course to diagonal rolling with the steel wheeled roller crossing the lines of the previous rolling while mixture is hot and in a compactible condition. Speed of the rollers shall be slow enough to avoid displacement of hot mixture. Correct displacement of mixture immediately by use of rakes and fresh mixture, or remove and replace mixture as directed. Continue rolling until roller marks are eliminated and course has a density of at least 97 percent but not more than 100 percent of that attained in a laboratory specimen of the same mixture prepared in accordance with ASTM D 1559. During rolling, moisten wheels of the rollers enough to prevent adhesion of mixture to wheels, but excessive water is prohibited. Operation of rollers shall be by competent and experienced operators. Provide sufficient rollers for each spreading machine in operation on the job and to handle plant output. In places not accessible to the rollers, compact mixture thoroughly with hot hand tampers. Skin patching of an area after compaction is prohibited. Remove mixture that becomes mixed with foreign materials or is defective and replace with fresh mixture compacted to the density specified herein. Roller shall pass over unprotected edge of the course only when laying of course is to be discontinued for such length of time as to permit mixture to become cold.

3.4 JOINTS

Joints shall present the same texture and smoothness as other portions of the course, except permissible density at the joint may be up to 2 percent less than the specified course density. Carefully make joints between old and new pavement or within new pavements in a manner to ensure a thorough and continuous bond between old and new sections of the course. Vertical contact surfaces of previously constructed sections that are coated with dust, sand, or other objectionable material shall be painted with a thin uniform coat of emulsion or other approved bituminous material just before placing fresh mixture.

3.4.1 Transverse

Roller shall pass over unprotected end of freshly laid mixture only when laying of course is to be discontinued. Except when an approved bulkhead is used, cut back the edge of previously laid course to expose an even, vertical surface for the full thickness of the course. When required, rake fresh mixture against joints, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll. Transverse joints in adjacent lanes shall be offset a minimum of 2 feet.

3.4.2 Longitudinal Joints

Space 6 inches apart. Do not allow joints to coincide with joints of existing pavement or previously placed courses. Spreader screed shall overlap previously placed lanes 2 to 3 inches and be of such height to permit compaction to produce a smooth dense joint. With a lute, push back mixture placed on the surface of previous lanes to the joint edge. Do not scatter mix. Remove and waste excess material. When edges of longitudinal joints are irregular, honeycombed, or poorly compacted, cut back unsatisfactory sections of joint and expose an even vertical surface for the full thickness of the course. When required, rake fresh mixture against joint, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll while hot.

3.5 FIELD QUALITY CONTROL

- c. Smoothness: Straightedge test the compacted surface of leveling, binder, and wearing courses as work progresses. Apply straightedge parallel with and at right angles to the closest adjacent curb after final rolling. Unevenness of leveling and binder courses shall not vary more than 1/4 inch in 10 feet; variations in the wearing course shall not vary more than 1/8 inch in 10 feet. Correct each portion of the pavement showing irregularities greater than that specified.
- d. Finished Grades: Finish grades of each course placed shall not vary from the finish elevations, profiles, and cross sections indicated by more than 1/2 inch. Finished surface of the final wearing course will be tested by running lines of levels at intervals of 25 feet longitudinally and transversely to determine elevations of completed pavement. Within 45 days after completion of final placement, perform a level survey at the specified grid spacing and plot the results on a plan drawn to the same scale as the drawings. Elevations not in conformance with the specified tolerance shall be noted on the plan in an approved manner. The survey shall be performed by a registered land surveyor. The Contracting Officer will inform the Contractor in writing of paved areas that fail to meet the final grades indicated within the specified tolerances. Correct deficient paved areas by removing existing work and replacing with new materials that meet the specifications. Skin patching for correcting low areas is prohibited.
- e. Finish Surface Texture of Wearing Course: Visually check final surface texture for uniformity and reasonable compactness and tightness. Final wearing course with a surface texture having undesirable irregularities such as segregation, cavities, pulls or tears, checking, excessive exposure of coarse aggregates, sand streaks, indentations, ripples, or lack of uniformity shall be removed and replaced with new materials.

3.5 PROTECTION

Do not permit vehicular traffic, including heavy equipment, on pavement until surface temperature has cooled to at least 120 degrees F. Measure surface temperature by approved surface thermometers or other satisfactory methods.

-- End of Section --

SECTION 02775

EXTERIOR CONCRETE SLABS, WALKS, AND CURBS

PART 1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI 223	(1983) Standard Practice for the Use of Shrinkage-Compensating Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 306R	(1988; R 2002) Cold Weather Concreting
ACI 316R	(1982) Construction of Concrete Pavements and Concrete Bases, Recommendations for
ACI 318	(2005) Building Code Requirements for Structural Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 260	(1997; R 2001) Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials
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ASTM INTERNATIONAL (ASTM)

ASTM C 172	(2004) Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2001e1) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(2004) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(2003) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2003a) Making and Curing Concrete Test Specimens in the Field
ASTM C 920	(2005) Elastomeric Joint Sealants
ASTM D 1751	(2004) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752	(2004a) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 5893	(2004) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

ODOT 499	(2005) Concrete General; and Subparts as Specified
ODOT 509	(2005) Reinforcing Steel; and Subparts as Specified
ODOT 511	(2005) Concrete for Structures; and Subparts as Specified
ODOT 701	(2005) Hydraulic Cement; and Subparts as Specified
ODOT 705	(2005) Concrete Pavement Incidentals; and Subparts as Specified
ODOT 709	(2005) Reinforcing Steel; and Subparts as Specified

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings for the following items shall be submitted showing size and spacing:

Reinforcing Steel
Bar Lists

Erection/Installation Drawings shall be submitted including the size and spacing for the following items:

Reinforcing Steel
Bar Lists
Expansion and Construction Joint Details

SD-03 Product Data

Concrete

Copies of certified delivery tickets for all concrete used in the construction.

SD-05 Design Data

Mix Designs shall be submitted for approval for each concrete class. The design for concrete properties shall equal or exceed the specified design properties.

SD-06 Test Reports

Test Reports for the following items shall be submitted in accordance with the paragraph entitled, "Concrete Testing During Construction:"

Slump
Air Content
Cylinder Test Specimens

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items demonstrating conformance with the referenced specifications contained in this section. Certificates must contain project name and Contract number, date, name of Contractor, name of concrete testing service, source and mineralogy of aggregates, complete catalog information for all manufactured products proposed and test results.

Reinforcing steel
Form materials
Curing and sealing materials
Joint materials
Concrete materials
Concrete mix design

SD-08 Manufacturer's Instructions

Manufacturer's Instructions for all products used shall be submitted, including any special instructions for equipment installation, for approval prior to use.

1.3 LABORATORY AND FIELD SAMPLING AND TESTING SERVICE

Sampling and testing services shall be provided by the Contractor at the direction of the Contracting Officers Technical Representative (COTR). The testing service agency shall be approved prior to commencing construction. The field testing shall be done to determine conformance with reference Textifications and for quality control.

1.4 Laboratory Testing

Laboratory testing shall consist of running compressive strength tests on concrete cylinders prepared in the field according to ASTM C 39.

1.5 Field Testing and Quality Control During Construction

Concrete shall be sampled and tested at the direction of the COTR and as follows:

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Sampling	ASTM C 172	As required for each test.

Slump	ASTM C 143	One for each concrete load; one each time water or an admixture is added to the mix.
Air Content	ASTM C 231	One at the point of delivery for each load and one for each set of compressive strength tests.
Compression test each	ASTM C 31	One set of four (4) standard specimens cylinders for compressive strength test.

1.6 WEATHER LIMITATIONS

1.6.1 Placing During Cold Weather

Concrete placement shall not take place when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.6.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 90 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F at any time.

1.7 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.7.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.7.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial

use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

PART 2 PRODUCTS

2.1 READY MIX CONCRETE

Concrete shall be ready-mix and shall conform to ASTM C 94.

The provisions contained in ODOT 499 apply to this specification as modified herein:

Minimum 28 day compressive strength of 281.2 kilograms per square centimeter (4000 psi).

Maximum chloride ion content of 0.30% by weight of cement in mix per cubic meter according to AASHTO T 260.

Air entrainment of 5% to 7% at point of placement.

Maximum delivered slump shall be (4 inches).

Maximum water-cement ratio shall be 0.40.

Course aggregate shall be limestone or dolomite only.

Mix water shall be potable.

2.2 Admixtures

The COTR shall approve all proposed admixture products prior to their use. The COTR, at his discretion, may direct the Contractor as to which admixtures to use. The application of all admixtures shall be done in strict accordance with the manufacturers instructions.

The Contractor is encouraged to use some or all of the following admixtures to ease constructability while complying with this specification and to produce a more durable product:

Slump may be increased to a maximum of (8 inches) by adding an approved superplasticizer at the job site to ease casting.

Note: water shall not be added at the job site for the purpose of increasing slump and easing casting.

Accelerator shall be non-corrosive and shall not contribute more than 0.005% chloride ion content by weight of cement and will comply with ASTM C 494, Type C.

A corrosion inhibiting admixture shall be included where concrete will be exposed to deicing salts or any other corrosive environment at the maximum rate allowed by the manufacturer.

Set-retarding admixture shall comply with ASTM C 494, Type D.

Water-reducing admixture shall comply with ASTM C 494, Type A.

Air-entraining admixture shall comply with ASTM C 260.

2.3 Shrinkage Compensating Concrete

The above specifications apply to this section and shall include the following:

Shrinkage compensating concrete shall be Type K constructed according to ACI 223 and ODOT 701.08.

Minimum cement content per cubic meter is 305.5 kilograms (515 pounds).

Maximum water-cement ratio can be increased to 0.50.

Maximum delivered slump is 100 mm (4 inches).

2.2 REINFORCING MATERIALS

2.2.1 Epoxy-Coated Reinforcing Steel

Epoxy-coated reinforcing bars shall meet the requirements of ODOT 709.

2.2.1.2 Deformed and Plain Billet Steel Bars for Concrete Reinforcement

Reinforcing bars shall meet the material requirements of ODOT 709.01.

2.4 CURING AND SEALING COMPOUND

Curing and sealing compound shall conform to ODOT 705.07 Type A and ASTM C 309.

2.5 JOINT FILLER STRIPS

2.5.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.5.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 1/2 inch thick, unless otherwise indicated.

2.6 JOINT SEALANTS

Joint sealant, cold-applied shall conform to ASTM C 920 or ASTM D 5893.

2.7 FORM MATERIALS

Forms shall be of wood, steel or other material approved by the COTR, and shall conform to ACI 318.

2.7.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.7.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 GENERAL

Concrete shall be constructed in accordance with ACI 318 Building Code, ACI 305R, ACI 306R, ACI 316R, and ODOT 511.

3.2 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in conformance with Section 31 23 16.17.98.

3.2.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.2.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.2.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.3.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope of 1/8 inch per foot with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.3 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours

nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.4 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.4.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.4.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.4.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.5.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.5.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.5.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces

shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.5.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.5.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.6 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.6.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.6.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D 1752 or building paper. Joint filler shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with cold-applied

joint sealant. Joint sealant shall be gray or stone in color. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.6.3 Reinforcement Steel Placement

The requirements of ODOT 509 shall be strictly adhered to.

Reinforcing bar shall be free of loose, flaky rust and scale as well as any other deleterious materials such as oil, grease or paint that would reduce the bond with the concrete. WWF shall be delivered and installed as flat sheets only.

Epoxy coated bar shall be installed as shown on the Contract drawings and according to ODOT 509.10.

Reinforcement shall be secured in the formwork or on the subgrade surface by ties and chairs of sufficient number and strength to prevent movement during placement and casting operations.

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.7 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.7.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

a. Contraction joints (except for slip forming) shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

b. When slip forming is used, the contraction joints shall be cut in the top portion of the gutter/curb hardened concrete in a continuous cut across the curb and gutter, using a power-driven saw. The depth of cut shall be at least one-fourth of the gutter/curb depth and 1/8 inch in width.

3.7.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints

at least 1/2 inch in width shall be provided at intervals not less than 30 feet nor greater than 120 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 1 inch depth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.8 CURING AND PROTECTION

3.8.1 General Requirements

Fresh concrete shall be cured in accordance with ODOT 511 Method (b) using an approved liquid membrane curing compound. Traffic on new concrete will be restricted for a minimum of 14 days to allow proper curing to occur.

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.8.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.8.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.9 FIELD QUALITY CONTROL

3.9.1 General Requirements

Quality control and field testing during construction is the responsibility of the Contractor.

Specimens shall be tested for compressive strength at 7 days and at 28 days.

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these

specifications are met.

3.9.2 Concrete Testing

3.9.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 100 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.9.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173/C 173M or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.9.2.3 Slump Test

A slump test shall be made on every batch of concrete placed. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.9.3 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.10 SURFACE DEFICIENCIES AND CORRECTIONS

3.10.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.10.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or

by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.10.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

SECTION 02920

LAWNS AND GRASSES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 92 (2003) Wire-Cloth Sieves for Testing
Purposes

ASTM INTERNATIONAL (ASTM)

ASTM D 2028 (1997; R 2004) Standard Specification for
Cutback Asphalt (Rapid-Curing Type)

ASTM D 2399 (1983; R 1999) Standard Practice for
Selection of Cutback Asphalts

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330,
"Submittal Procedures," in sufficient detail to show full compliance with
the specification:

SD-09 Manufacturer's Field Reports

Laboratory analysis of Grass Seed for percent pure, percent
germination, and percent weed seed, along with laboratory analysis
of proposed Top Soil shall be submitted.

1.3 SAMPLING AND TESTING

Sampling and testing of grass seed and topsoil shall be by an approved
testing service and show compliance with all specified requirements.

1.4 DELIVERY AND STORAGE

1.4.1 Seed and Fertilizer

Grass seed and fertilizer shall be delivered in sealed containers or bags,
each labeled in accordance with the applicable federal and state
regulations and bearing the name, trade name or trademark, and
certification of the producer.

Packaged materials shall be stored off the ground, under watertight cover,
and away from damp surfaces.

1.4.2 Sod Delivery

Dumping from vehicles will not be permitted. If stacked during transit or

storage, the sod shall be placed roots to roots or grass to grass. During delivery and while in stacks, sod shall be kept moist and cool, and protected from sun, air, and freezing.

1.5 WEATHER LIMITATIONS

Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition detrimental to grass seed planting or finish grading. Sodding shall be performed between April 1 and May 30 or between August 15 and October 1.

Seeding shall be done between April 1 and May 30, or between August 15 and October 1, unless otherwise permitted.

PART 2 PRODUCTS

2.1 TOPSOIL

Topsoil previously removed and stockpiled shall be used in the work. Topsoil shall be free from subsoil, litter, and other objectionable material.

Topsoil shall be fertile, friable, natural surface soil obtained from well-drained areas and possessing characteristics of representative soils in the project vicinity that produce heavy growths of crops, grass, or other vegetation. Topsoil shall be free of material that might be harmful to plant growth or hindrances to planting or maintenance operations.

Chemical and physical properties of topsoil proposed for use in the work shall be as follows:

Organic matter shall be at least 6 percent as determined by loss on ignition of moisture-free samples of topsoil.

The pH range shall be from 5.0 to 7.0.

The physical analysis of the topsoil shall be within the following limits: (AASHTO M 92)

<u>SIEVE SIZE</u>	<u>PERCENT PASSING</u>
1 inch	99 to 100
1/4 inch	97 to 99
No. 100	40 to 60
No. 200	20 to 40

2.2 TOPSOIL BLEND

Where insufficient topsoil is removed from the project site, the topsoil removed shall be stockpiled and blended with compost at the site to achieve the required volume.

2.3 GRASS SEED

Grass seed for lawn areas shall be as follows:

<u>KIND OF GRASS SEED</u>	<u>GRASS SEED IN MIXTURE BY WEIGHT PERCENTAGE</u>	<u>GRASS SEED PURITY MINIMUM PERCENTAGE</u>	<u>GRASS SEED GERMINATION MINIMUM PERCENTAGE</u>
Annual rye grass	20	98	90
Kentucky Fescue	40	98	85
Creeping Red Fescue	40	97	85

Grass seed which has become wet, moldy, or otherwise damaged in transit or storage will not be acceptable.

2.4 FERTILIZER

Fertilizer shall be commercial Grade 10-10-10 mixed fertilizer.

2.5 MULCH

Mulch shall be salt or bahia hay or threshed straw of wheat, rye, oats, or barley and shall be clean and free of seeds.

Mulch that is fresh and excessively brittle or that is in such an advanced stage of decomposition as to smother or retard the growth of grass will not be acceptable.

2.6 ASPHALT EMULSION

Asphalt emulsion shall meet the requirements of ASTM D 2028 or ASTM D 2399.

PART 3 EXECUTION

3.1 TOPSOIL PREPARATION

3.1.1 Subgrade

Before topsoil is placed, the subgrade surface shall be cleared of all materials that might hinder the performance of the work or subsequent maintenance operations.

3.1.2 Grading

Grades on areas that have been previously established shall be maintained in a true and even condition.

Where grades have not been established and where improperly graded, areas shall be uniformly graded. Finished surfaces shall be smooth within a tolerance of 0.1-foot above or below the indicated subgrade elevations, with uniform levels or slopes between the points where elevations are indicated or between such points and existing grades and free from irregular surface changes to prevent the formation of depressions where water will accumulate.

3.1.3 Placing Topsoil

Suitable topsoil shall be placed in the top 4 inches of all grassed areas stripped under this project. All areas to receive topsoil, including cut

and fill areas, shall be shaped to provide a minimum of 4 inches topsoil. Prior to placement of the topsoil, the subgrade shall be scarified to a depth of 2 inches. Topsoil shall be uniformly distributed and evenly spread to an average thickness of 4 inches. Spreading shall be performed in such a manner that planting can proceed with little additional soil preparation or tillage, and the area shall be left smooth and suitable for lawns. Irregularities in the surface from topsoiling or other operations shall be corrected so as to prevent the formation of depressions where water will stand. Topsoil shall not be hauled and placed when wet or when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to the proposed planting or to proper grading. Topsoil shall be spread uniformly but shall not be compacted. Where any portion of the surface becomes gullied or otherwise damaged, the affected area shall be repaired to establish the condition and grade prior to topsoiling, and then shall be re-topsoiled.

3.1.4 Application of Fertilizer

Fertilizer shall be uniformly distributed over the topsoil surface at a rate of 10 pounds per 1,000 square feet, and incorporated into the topsoil to a depth of at least 1 inch by discing, harrowing, or other approved means.

Fertilizer may be applied mixed with seed and water as specified in paragraph entitled, "Seeding."

3.1.5 Smooth Grading

Undulations or irregularities in the topsoil surface resulting from operations shall be leveled.

Topsoil surface shall be made smooth and uniform.

3.1.6 Cleanup

After smooth grading, the topsoil surface shall be cleared of stones or other objects that might be a hindrance to planting or maintenance operations.

Topsoil or other material that has been brought upon the surfacing of paved areas by operations shall be removed daily.

3.2 SEEDING

3.2.1 Method of Sowing

Seeding, making use of a mixture of seed, fertilizer, and water applied by special mobile equipment designed for the purpose, may be employed subject to approval. When the above method of seeding is employed, covering seed and compaction operations specified will be waived.

3.2.2 Preparation of Seedbed

Seedbed shall be loose and porous at the time of seeding. When necessary, the seedbed shall be loosened to a depth of at least 3 inch by harrowing or other suitable means and the surface smooth-graded and cleared of objectionable material as specified.

3.2.3 Planting Seed

Grass seed shall be uniformly distributed over the prepared seed bed.

For lawn areas, the rate of seeding shall be 3 pounds per 1,000 square feet.

For field grass areas, the rate of seeding shall be 3 pounds per 1,000 square feet.

Immediately after seed planting, the area shall be lightly raked or lightly harrowed to cover the seed to an average depth of 1/4 inch.

3.2.4 Compacting

Immediately after the completion of seeding operations and raking, the entire area shall be compacted by means of suitable compacting equipment.

Compacting equipment shall consist of approved equipment weighing 60 to 90 pounds per linear foot of roller width and shall be suitable for the soil material being compacted. Wheels of pneumatic-tired rollers shall be so spaced that one pass of the roller will accomplish complete coverage equal to the rolling width of the equipment.

3.3 MULCHING

3.3.1 Placing Mulch

Not more than 48 hours after the completion of seeding operations, mulch shall be spread uniformly over the entire area in a continuous blanket having a depth of not more than 1-1/2-inches loose measurement using approximately 2 tons of mulch per acre.

Mulch shall be spread by hand or approved equipment. Mulching shall be started at the windward side of relatively flat areas, at the upper part of steep slopes, and shall continue uniformly until the area is completely covered.

3.3.2 Anchoring Mulch with Asphalt Emulsion

Mulch shall be anchored in place by a spray coating of asphalt emulsion uniformly applied at the rate of 11 to 14 gallons per 1,000 square feet. Precautions shall be taken to prevent the asphalt emulsion from damaging or disfiguring structures and other property on or adjacent to the mulched area.

3.3.3 Anchoring Mulch with Machinery

Mulch shall be anchored in place by a Coulter disc mulch-anchoring machine or other suitable equipment that will secure the mulch firmly in the ground to form a soil-binding mulch and prevent loss or bunching of the mulch by the wind. The number of passes over the mulch needed to secure it firmly to the soil shall in no case exceed three.

On slopes and other areas where machinery cannot be satisfactorily used, the mulch shall be anchored in place by a spray coating of asphalt emulsion, by twine and softwood stakes, or by other approved means.

3.4 GRASS ESTABLISHMENT

3.4.1 General

The period of grass establishment shall begin immediately after the completion of mulching in an area and shall continue for a period of 2-months after the completion of seeding on the entire project unless the desired grass cover is established in a shorter period of time and shortening of the grass-establishment period is authorized.

3.4.2 Watering

Contractor shall provide and maintain temporary piping and lawn-watering equipment required to convey water from the water source to uniformly water the seeded areas. Water shall be free from substances detrimental to the growth of vegetation. Water sources located on Government property will be subject to approval prior to use. Temporary watering equipment shall be removed after grass area acceptance.

Watering schedules shall be arranged and lawn-watering equipment laid out in a manner to avoid the necessity of walking over muddy and newly seeded areas.

Watering shall be done in a manner to prevent the displacement of seed and mulch and to prevent puddling and water erosion.

Immediately after the completion of mulching in an area, the area shall be moistened to a depth of 3 inches or more.

After the initial watering, the seeded areas shall be watered as required to maintain the soil in a moist condition for the entire grass-establishment period.

3.4.3 Weeding

Weeds or other undesirable vegetation that threaten to smother the grass shall be uprooted and removed from the area.

3.4.4 Reseeding

After the first mowing, bare areas shall be reseeded.

Reseeding shall be with the grass seed specified for each seeded area and shall be sown at the rate specified and in a manner that will cause a minimum of disturbance to the existing stand of grass and mulch.

3.4.5 Remulching

In areas where mulch has been disturbed sufficiently to nullify its purpose, new mulch shall be added and anchored as specified.

3.5 ACCEPTANCE PROVISIONS

3.5.1 Acceptance Requirements

Completed grass areas shall have been recently mowed and be covered with a uniform stand of the specified grass, be free of rank growths of weeds or other undesirable vegetation, and be free of irregular surface changes and other depressions where water will accumulate.

Scattered bare spots not larger than 6 inches in any dimension will be allowed, up to a maximum of 3 percent of any grass area.

Condition of grass areas at the time of inspection will be noted and a determination, made whether the grass-establishment period shall be extended for any area.

3.5.2 Repairs

If, before completion and acceptance of the entire work, portions of the surface become gullied or otherwise damaged following seeding or the grass seedings have been destroyed, the affected area shall be repaired to re-establish the condition and grade of the soil prior to seeding and then re-seeded, remulched, and the grass established as specified.

3.6 PROTECTION

Seeded areas shall be protected against traffic or other use by erecting barricades around each area immediately after seeding is completed and by placing warning signs of an approved type on each seeded area.

-- End of Section --

SECTION 16003

GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2002) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA Z 535 (1991) Safety Color Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MS MIL-T-704 (Rev K) Treatment and Painting of Material

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS W-J-800 (Rev F) Junction Box: Extension, Junction Box; Cover, Junction Box (Steel, Cadmium, or Zinc-Coated)

UNDERWRITERS LABORATORIES (UL)

UL-05 (1995) Electrical Construction Materials Directory

1.2 SUBMITTALS

Not Used

1.3 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

It is the intent of these specifications and the contract drawings to provide a complete and workable facility.

Design drawings are diagrammatic and do not show all offsets, bends, elbows, or other specific elements that may be required for proper installation of the work. Such work shall be verified at the site. Additional bends and offsets, and conduit as required by vertical and

horizontal equipment locations or other job conditions, shall be provided to complete the work at no additional cost to the Government.

Except where shown in dimensional detail, the locations of switches, receptacles, lights, motors, outlets, and other equipment shown on plans are approximate. Such items shall be placed to eliminate interference with ducts, piping, and equipment. Exact locations shall be determined in the field. Door swings shall be verified to ensure that light switches are properly located.

Equipment sizes indicated are minimum. Before installing any wire or conduit, the Contractor shall obtain the exact equipment requirements and shall install wire, conduit, disconnect switches, motor starters, heaters, circuit breakers, and other items of the correct size for the equipment actually installed. Wire and conduit sizes shown on the drawings shall be taken as a minimum and shall not be reduced without written approval.

1.4 CODES AND STANDARDS

Equipment design, fabrication, testing, performance, and installation shall, unless shown or specified otherwise, comply with the applicable requirements of NFPA 70 and IEEE C2 to the extent indicated by the references.

1.5 COORDINATION

Installation of the electrical work shall be coordinated with the work of other trades.

1.6 APPROVAL REQUIREMENTS

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories (UL), Inc., the label of, or listing with re-examination, in UL-05 will be acceptable as sufficient evidence that the items conform to the requirements.

Where materials or equipment are specified to be constructed or tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized standards, a manufacturer's certificate of compliance indicating complete compliance of each item with the applicable NEMA, ANSI, ASTM, or other commercial standards specified will be acceptable as proof of compliance.

1.7 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall be given a rust-inhibiting treatment and the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09960 HIGH PERFORMANCE COATINGS.. Aluminum shall not be used in contact with earth or concrete. Dissimilar metals in intimate contact shall be protected by approved fittings, barrier material, and treatment. Ferrous metals such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123/A 123M for exterior locations and cadmium-plated in conformance with FS W-J-800 for interior locations.

1.8 HAZARDOUS AREA

Electrical work within any hazardous location shall meet the applicable requirements of NFPA 70, Chapter 5, Articles 500 through 517. The following definitions apply:

Explosionproof: A receptacle, fixture, device, or equipment enclosure that is designed to withstand explosion of a specified liquid, gas, vapor, or dust within the enclosure and to prevent the ignition of a specified gas, vapor, or dust surrounding the enclosure by sparks, flashes, or explosions of the specified liquid, gas, vapor, or dust that may occur within the enclosure. Enclosure shall be capable of operating at an external temperature that will not ignite a surrounding flammable atmosphere.

Hazardous location: An area where ignitable vapors or dust may cause a fire or explosion created by energy emitted from lighting or other electrical equipment or by electrostatic generation.

NFPA 70, Article 500-2 lists chemical atmospheres by groups A, B, C, and D. In addition, although not defined as a hazardous material by the NEC, oxygen concentrations (liquid and gaseous) are considered to provide a hazard because of the increased flammability of materials exposed to oxygen. Therefore, oxygen concentrations shall be classified under Group D.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

Identification plates shall be 3-layer white-black-white, engraved to show black letters on a white background. Letters shall be uppercase. Identification plates 1-1/2 inches high and smaller shall be 1/16-inch thick with engraved lettering 1/8-inch high. Identification plates larger than 1-1/2 inches high shall be 1/8-inch thick with engraved lettering not less than 3/16-inch high. Identification plates having edges of 1-1/2 inches high and larger shall be beveled.

2.2 WARNING SIGNS

Each item of electrical equipment operating at 480 volts and above shall be provided with conspicuously located warning signs conforming to the requirements of Occupational Safety and Health Agency (OSHA) standards.

Any equipment with externally powered wiring shall be marked with a laminated plastic nameplate having 3/16-inch high white letters on a red background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

Safety color coding for identification of warning signs shall conform to NEMA Z 535.

2.3 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or slabs.

2.4 SEISMIC ANCHORAGE

Electrical equipment, except communications, emergency, and standby equipment, shall be anchored to withstand a lateral force of 0.3 times the weight of the equipment.

Communications, emergency, and standby equipment shall be anchored to withstand a lateral force of 0.6 times the weight of the equipment.

The following standard anchoring should be adequate for equipment not classified as communications, emergency, or standby:

Dry transformers - floor-mounted with four anchor bolts

BOLT DIAMETER

Under 150 kVA	-	3/8
150 to 500 kVA	-	1/2
Over 500 kVA	-	5/8

Panels - floor-mounted with four 1/2-inch diameter anchor bolts

2.5 PAINTING

Enclosures of the following listed items shall be cleaned, primed, and factory-painted inside and outside in accordance with MS MIL-T-704. Refer to Section 09960 HIGH PERFORMANCE COATINGS, for requirement for outdoors or in harsh environments..

ITEM	FINISH COLOR
Circuit Breakers	ANSI No. 61 gray
Substations	ANSI No. 61 gray
Switchgear	ANSI No. 61 gray
Transformers	ANSI No. 61 gray
Safety Switches	Manufacturer's standard
Panelboards	Manufacturer's standard
Electric Heaters	Manufacturer's standard
Motors	Manufacturer's standard
Limit Switches	Manufacturer's standard
Control Components	Manufacturer's standard

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be accomplished by workers skilled in this type of work. Installation shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors. Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations.

3.2 PAINTING APPLICATION

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks, if

not factory painted, shall be thoroughly cleaned and painted as specified in Section 09920 ARCHITECTURAL PAINTING unless otherwise noted. Work shall be left in a neat and clean condition at final completion of the contract.

Emergency equipment, such as fire-alarm boxes, shall be cleaned, primed, and painted red.

3.3 IDENTIFICATION PLATE INSTALLATION

Identification plates shall be fastened by means of corrosion-resistant steel or nonferrous metal screws. Hand lettering, marking, or embossed self-adhesive tapes are not acceptable.

3.4 EQUIPMENT PADS

Equipment pads shall be constructed with a minimum 4-inch margin around the equipment and supports.

3.5 CUTTING AND PATCHING

Contractor shall install his work in such a manner and at such time as will require a minimum of cutting and patching on the building structure.

Holes in or through existing masonry walls and floors in exposed locations shall be drilled and smoothed by sanding. Use of a jackhammer will be permitted only where specifically approved.

3.6 DAMAGE TO WORK

Required repairs and replacement of damaged work shall be done as directed by and subject to the approval of the Contracting Officer, and at no additional cost to the Government.

3.7 CLEANING

Exposed surfaces of wireways, conduit systems, and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish or painting or are enclosed within the building structure.

Before final acceptance, electrical equipment, including lighting fixtures and glass, shall be clean and free from dirt, grease, and fingermarks.

3.8 FIELD TESTING AND TEST EQUIPMENT

All Field testing specified in Divisions 16 electrical specification shall be made with test equipment specially designed and calibrated for the purpose. Test equipment used shall be calibrated and certified by an approved testing laboratory. Date of last calibration and certification shall not be more than 90 days old at the time of field testing.

-- End of Section --

SECTION 16145

STANDARD WIRING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1 (1994; R 1995) Rigid Steel Conduit - Zinc Coated

ANSI C80.3 (1994; R 1995) Electrical Metallic Tubing - Zinc-Coated

ASTM INTERNATIONAL (ASTM)

ASTM B 173 (2001a) Standard Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors

ASTM B 3 (2001) Standard Specification for Soft or Annealed Copper Wire

ASTM D 2301 (1999) Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 383 (1974; R 1992) Standard for Type Test Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FB 1 (2001) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies

NEMA KS 1 (2001) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

NEMA RN 1 (1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA TC 3 (2004) PVC Fittings for Use With Rigid PVC Conduit and Tubing

NEMA WC 5	(1992; R 1993) Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(2002) National Electrical Code
UNDERWRITERS LABORATORIES (UL)	
UL 1	(2004) UL Standard for Safety - Flexible Metal Conduit
UL 1242	(2003) UL Standard for Safety - Intermediate Metal Conduit
UL 1581	(2003) UL Standard for Safety - Reference Standard for Electrical Wires, Cables, and Flexible Cords
UL 486C	(2002) UL Standard for Safety Splicing Wire Connectors
UL 50	(2003) UL Standard for Safety - Enclosures for Electrical Equipment
UL 514A	(2004) UL Standard for Safety - Metallic Outlet Boxes
UL 514B	(2004) UL Standard for Safety Fittings for Conduit and Outlet Boxes
UL 6	(2003) UL Standard for Safety for Electrical Rigid Metal Conduit-Steel
UL 651	(2002) UL Standard for Safety Schedule 40 and 80 Rigid PVC Conduit
UL 797	(2003) UL Standard for Safety - Electrical Metallic Tubing
UL 83	(2004) UL Standard for Safety Thermoplastic-Insulated Wires and Cables

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists shall be submitted for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Conduit, Raceways and Fittings G
Wire and Cable G
Safety Switches G
Flush Wiring Devices G
Boxes and Fittings G
Communication Cabinets G

SD-02 Shop Drawings

The following types of drawings shall be submitted to check for contract conformity:

Fabrication Drawings
Assembly Drawings

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Conduit, Raceways and Fittings G
Wire and Cable G
Safety Switches G
Flush Wiring Devices G
Boxes and Fittings G
Communication Cabinets G

SD-06 Test Reports

Test Reports shall be submitted for standard wiring systems in accordance with the paragraph entitled, "Field Testing," of this section.

SD-07 Certificates

Certificates of compliance shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Conduit, Raceways and Fittings
Wire and Cable
Safety Switches
Flush Wiring Devices
Boxes and Fittings
Communication Cabinets

1.3 FABRICATION AND ASSEMBLY DRAWINGS

Fabrication Drawings shall be submitted for the standard wiring systems consisting of fabrication and Assembly Drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements for the contract documents.

PART 2 PRODUCTS

2.1 CONDUIT, RACEWAYS AND FITTINGS

Conduit shall be 3/4-inch diameter minimum, except where specifically shown smaller on the contract drawings, and except for exposed switch leg runs.

Conduit, connectors, and fittings shall be approved for the installation of electrical conductors.

2.1.1 Intermediate Metal Conduit

Intermediate metal conduit, including couplings, elbows, bends, and nipples, for use as a raceway for wire and cables in an electrical system shall conform to the requirements of UL 1242 as amended for thin or thick-wall types and shall also conform to NFPA 70. Interior and exterior surfaces of the conduit shall be protected with a metallic zinc coating.

2.1.2 Rigid Steel Conduit

Rigid steel conduit, including couplings, elbows, bends, and nipples, shall conform to the requirements of UL 6 and ANSI C80.1, Steel fittings shall be galvanized by the hot-dip process. Where indicated, rigid steel conduit shall be polyvinylchloride (PVC) coated and conform to NEMA RN 1, Type 20.

Fittings for rigid steel conduit shall be threaded and shall conform to NEMA FB 1.

Gaskets shall be solid for fittings sized 1-1/2 inches and less. Conduit fittings with blank covers shall have gaskets except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and shall be accessible after the work has been completed.

2.1.3 Rigid Plastic Conduit

PVC conduit shall be not lighter than Schedule 40. Rigid PVC shall be the slip-joint solvent-weld type, and fittings shall be unthreaded solid PVC. Conduit and fittings shall conform to UL 651 and NEMA TC 3.

2.1.4 Electrical Metallic Tubing (EMT)

EMT shall be rigid metallic conduit of the thinwall type in straight lengths, elbows, or bends and shall conform to ANSI C80.3 and the requirements of UL 797.

Couplings and connectors shall be hex-nut expansion-gland type, zinc-plated. Crimp, spring, or setscrew type fittings are not acceptable. Where EMT enters outlet boxes, cabinets, or other enclosures, connectors shall be the insulated-throat type, with a locknut. Fittings shall meet the requirements of NEMA FB 1.

2.1.5 Flexible Metallic Conduit

Flexible metallic conduit shall meet the requirements of UL 1.

Liquidtight flexible metallic conduit shall be provided with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Fittings for flexible metallic conduit shall meet the requirements of UL 514B, Type I box connector, electrical, Type III coupling, electrical conduit, flexible steel, or Type IV adapter, electrical conduit.

Fittings for liquidtight flexible metallic conduit shall meet the requirements of UL 514B, Type I box connector, electrical, Class 3 liquidtight flexible metallic conduit connectors.

2.2 WIRE AND CABLE

Insulated current-carrying wire and grounding conductors shall be copper and shall conform to NFPA 70 and UL 1581. Wire bundles with cable ties shall be secured to the enclosure with sheet-metal screws. Self-sticking adhesive attachments are not acceptable.

2.2.1 Building Wire

Building wire for use in conduits, raceways, and wireways shall be single-conductor, 600-volt, heat- and moisture-resistant insulated wire suitable for use in wet or dry locations.

Conductors AWG No. 10 and smaller shall be solid round copper wire. Conductors AWG No. 8 and larger shall be standard concentric stranded copper wire. Conductors shall be not less than AWG No. 12, except that AWG No. 14 shall be stranded copper wire and shall be used for control wiring.

Building wire shall be Type THHN with insulation of PVC and nylon jacket, with a minimum temperature rating of 90 degrees C.

2.2.2 Switchboard Wire

Switchboard wire used for instrument and control wiring on the back of switchboards and hinged-front instrument panels shall be single-conductor, 600-volt, flame- and heat-resistant insulated wire not smaller than AWG No. 14 with a minimum temperature rating of 90 degrees C.

Conductors rigidly mounted on the back of switchboards and instrument panels shall be solid round, soft or annealed, copper wire conforming to ASTM B 3. Hinge connections shall be rope-lay-stranded copper conductors, Class H, conforming to ASTM B 173. All wires before stranding shall conform to ASTM B 3 for soft or annealed copper wire.

Switchboard wire shall be Type SIS with cross-linked thermosetting polyethylene insulation.

2.2.3 Cable Tray Wire

Power and control wire installed in cable trays shall be Type TC cable 600 volts, with current-carrying capacity as determined by NFPA 70. Cable shall also comply with UL 83 and IEEE Std 383.

2.2.4 Standard Flexible Cable

Flexible multiconductor cable shall conform to UL 1581 for control and power below 600 volts, noninstrumentation type. Cable shall contain one (green) grounding conductor and shall utilize a thermosetting or thermoplastic overall jacket in accordance with NEMA WC 5. A white conductor shall be included for the power neutral or grounded current-carrying conductor. Cable conductor insulation shall conform to NEMA WC 5.

2.2.5 Splices and Connectors

Splices in building wire AWG No. 8 and smaller and multiple conductor cables shall be made with insulated Scotchlock, or equal, connectors or with indentor crimp-type connectors and compression tools to ensure a satisfactory mechanical and electrical joint.

Splices in building wire AWG No. 6 and larger and single-conductor cables shall be made with indentor crimp-type connectors and compression tools or with bolted clamp-type connectors to ensure a satisfactory mechanical and electrical joint.

Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor. Splices in rubber-insulated neoprene-jacketed wire and cables shall be watertight.

Vinyl-plastic electrical insulating tape shall meet the requirements of ASTM D 2301. Where pressure-sensitive tape is used, the surface shall be cleaned free of dust, sand, or other foreign material and a primer recommended by the tape manufacturer shall be applied prior to taping.

Where indicated and for building wire AWG No. 8 and larger, terminations shall utilize screw-set pressure terminal lugs.

Where indicated, building wire AWG No. 10 and smaller shall be terminated in pre-insulated crimp ring lugs on terminal blocks.

Solid wiring shall be terminated with terminal blocks specifically designed for solid wire. Crimp type shall not be used on solid wire for termination.

Stranded wire shall use crimp type lugs for termination on terminal blocks.

2.3 SAFETY SWITCHES

Switches shall comply with NEMA KS 1.

Safety switches shall be the heavy-duty type with voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, with the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and shall be so constructed that an external tool (screwdriver) must be used to open the cover. Provisions shall be made to lock the handle in the "OFF" position, but the switch handle shall not be capable of being locked in the ON position.

Switches shall be the quick-make, quick-break type. Terminal lugs shall be approved for use with copper conductors.

2.4 BOXES AND FITTINGS

Boxes shall have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NFPA 70 and UL 514A. Boxes that are exposed to the weather or that are in normally wet locations shall be cast-metal with threaded hubs. Surface-mounted boxes on interior walls shall be cast-metal. Boxes in other areas shall be cadmium-plated or zinc-coated sheet metal.

2.4.1 Pull and Junction Boxes

Pull and junction boxes shall be fabricated from carbon steel and shall conform to UL 50. Box dimensions and conduit connections shall conform to NFPA 70.

Boxes shall be welded construction with flat removable covers fastened to the box with machine screws. Seams and joints at corners or back edges of the box shall be closed and reinforced with flanges formed of the same material from which the box is constructed or by other means such as continuous welding which provides a construction equivalent to integral flange construction.

Boxes intended for outdoor use shall be cast with threaded hubs and neoprene-gasketed covers.

Boxes intended for use in dry locations shall be sheet steel galvanized after fabrication conforming to UL 514A.

PART 3 EXECUTION

3.1 INSTALLATION

Power, lighting, control emergency light and power, and special-service systems and all related components shall be installed in accordance with NFPA 70, and shall be enclosed in separate conduit or separate conduit systems.

Any run of EMT, intermediate, or rigid conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall contain not more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting. Field bends shall be made in accordance with the manufacturer's recommendations, which normally require use of a one-size-larger bender than would be required for uncoated conduit. Installed conduit and fittings shall be free of dirt and trash and shall not be deformed or crushed. Empty conduit shall have a pull rope stalled.

Conduit shall be installed with a minimum of 3 inches of free air space separation from mechanical piping.

Conduit in finished areas shall be installed concealed. Conduit passing through masonry or concrete walls shall be installed in sleeves.

Conduit shall be securely clamped and supported at least every 10 feet vertically and 8 feet horizontally. Galvanized pipe straps shall be fastened to structure with bolts, screws, and anchors. Wooden masonry plugs shall not be used.

Conduit and boxes shall not be supported from T-bar ceiling wires.

Conduit connections to boxes and fittings shall be supported not more than 36 inches from the connection point. Conduit bends shall be supported not more than 36 inches from each change in direction. Conduit shall be installed in neat symmetrical lines parallel to the centerlines of the building construction and the building outline. Multiple runs shall be parallel and grouped whenever possible on common supports.

Conduit and raceway runs in or under concrete, in damp, corrosive, or

outdoor locations, in hazardous areas, where subject to mechanical damage, or intended for conductors rated over 600 volts, shall be rigid steel conduit. Conduit joints in corrosive areas shall be painted with corrosion or acid-inhibiting compounds.

Wire or cable shall not be installed in conduit until the conduit system is completed; the inner surfaces of conduit shall be clean and dry.

A nylon or polypropylene pull rope with a tensile strength not less than 130 pounds shall be installed in empty conduit.

3.1.1 Installation of Rigid Metal Conduit

Ends of conduit shall be cut square, reamed and threaded, and joints shall be brought butt-to-butt in the couplings. Joints shall be mechanically tight. Conduit shall be protected against damage and the entrance of water or foreign material during construction.

Ninety-degree bends of conduit with a diameter larger than 1 inch shall be made with factory-made elbows. Conduit elbows larger than 2-1/2 inches shall be long radius. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Changes in directions of runs shall be made with symmetrical bends or cast-metal fittings.

At connections to sheet metal enclosures and boxes, a sufficient number of threads shall project through to permit the bushing to be drawn tight against the end of the conduit, after which the locknut shall be pulled up sufficiently tight to draw the bushing into firm electrical contact with the box. Conduit shall be fastened to sheet metal boxes and cabinets with two locknuts where required by NFPA 70 where insulating bushings are used, where bushings cannot be brought into firm contact with the box, and where indicated.

Conduit joints shall be made with tapered threads set firmly. Each length of conduit cut in the field shall be reamed before installation. Where conduit is threaded in the field, each threaded end shall consist of at least five full threads. Corrosion-inhibitive compound shall be used on conduit threads in exterior areas.

Conduit stubbed-up through concrete floors for connections to free-standing equipment except motor-control centers, cubicles, and other such items of equipment shall be provided with a flush coupling if the floor slab is of sufficient thickness; if not, a floor box shall be provided and set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.1.2 Installation of Rigid PVC Conduit

Rigid PVC conduit for underground work shall be encased in a concrete envelope or direct buried as specified for underground ducts. Where suitable protection is provided, PVC can be run exposed particularly in high corrosion areas.

A continuous, bare, soft-drawn copper ground wire shall be run in conduit with conductors and shall be solidly connected to ground at each end. Ground wires shall be sized in accordance with NFPA 70.

Rigid PVC conduit shall be stored on a flat surface and shall be protected from the direct rays of the sun.

3.1.3 Installation of Flexible Metallic Conduit

Flexible metallic conduit shall be installed only in exposed, accessible locations in accordance with NFPA 70. A grounding green conductor shall be installed in all runs. Connections to motors and vibrating equipment shall be made with flexible metallic conduit.

3.2 INSTALLATION OF WIRING

Raceways shall be completely installed, with interiors protected from the weather, before proceeding with the installation of wires and cables. Conductors of special-service systems and emergency light and power systems shall not occupy the same enclosure with light and power conductors or the same enclosure with each other. Conductors shall be continuous with splices and connections made in outlet, junction, or pull boxes only. All control wiring shall be continuous between components and/or terminal boards.

Phase conductors and the neutral conductor of each branch or feeder circuit shall be contained in a single enclosure or paralleled in separate enclosures to avoid overheating the raceway by electromagnetic induction. Conductors and conduit in parallel shall be the same length and size, shall have conductors of the same type of insulation, shall be terminated at both ends in a manner to ensure equal division of the total current among conductors, and shall have a separate neutral conductor in each conduit.

Sharing of a common neutral between single phase circuits, connected to different phases, shall not be permitted.

Conductors installed in heavy-wall rigid steel conduit and EMT shall have allowable current-carrying capacity and ampere ratings in accordance with NFPA 70. Larger-sized conductors shall be used to compensate for derating factors when more than three current-carrying conductors are installed in raceways and when conductors are installed in wet locations.

Conductors 600 volts and below shall be color coded in accordance with the following:

<u>CONDUCTOR</u>	120/208 <u>COLOR</u>
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Equipment Grounds	Green

Conductors up to and including AWG No. 2 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 2 shall have ends identified with colored plastic tape in outlet, pull, or junction boxes. Control circuit conductors shall be identified at each connection point.

Connectors and splices shall conform to UL 486C and shall be made in approved enclosures utilizing solderless pressure connectors and adequate insulation with vinyl-plastic electrical insulating tape. Conductors and

materials used in a splice, tap, or connection shall be thoroughly cleaned prior to makeup to ensure good electrical and mechanical connections. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match that shown on approved shop drawings. Hand lettering or marking is not acceptable. Control-circuit terminals of equipment shall be properly identified by color-coded insulated conductors, number-coded plastic self-sticking printed markers, or permanently attached metal-foil markers. Cable fittings shall conform to UL 514B; insulating tape shall conform to ASTM D 2301.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation. Tags shall be engraved laminated phenolic, with black lettering, 1/8 inch high, on white background, fastened to cables by means of tie wrap through a hole drilled at one end of the tag.

Grounding shall be provided in accordance with NFPA 70. Noncurrent-carrying parts of electrical equipment shall be bonded and grounded together.

3.3 WIRING DEVICES

3.3.1 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 15-ampere, 125-volt, single-phase, duplex, convenience outlets shall be suitably engraved, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle; for example: RP1-12, 208 VOLTS, 60 HERTZ, 3-PHASE, 30 AMPERES. If engraving is not practical, an engraved laminated phenolic identification plate may be applied.

Device plates shall be identified on the inside by circuit number and panelboard.

3.4 FIELD TESTING

Test reports shall be submitted in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, wire and cable shall be given continuity and insulation tests as herein specified before the conductors are energized.

Necessary test equipment, labor, and personnel shall be provided by the Contractor to perform the tests, as herein specified. Continuity tests shall be conducted using a dc device with bell or buzzer.

Wire and cable in each voltage classification shall be completely isolated from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Insulation tests on circuits rated 480-volts and less shall be conducted using a 500- or 1,000-volt insulation-resistance test set. Readings shall

be taken every minute until three equal and consecutive readings are obtained. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Insulation tests on circuits rated 240 volts or less, with conductor sizes 2 AWG and larger, shall be conducted using a 500- or 1,000-volt insulation-resistance test set. Readings shall be taken after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Phase-rotation tests shall be conducted on all three-phase circuits using a phase-rotation indicating instrument. Phase rotation of electrical connections to connected equipment shall be clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. No conductor shall be energized until the installation is approved.

-- End of Section --

SECTION 16901

TELEMETERING SYSTEM

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings G

Shop Drawings are to be complete including details of connections, wiring, piping, interfacing, devices, sizes, and dimensions.

SD-03 Product Data G

All significant equipment to be supplied shall be listed by descriptive data sheets. The equipment list shall include each component name, manufacturer, model number, a description of the operation, quantity, supplied, and any special setup.

Drawings of equipment to be supplied shall include, as a minimum, overall dimensional details for each unit including installation arrangements and door-mounted operator devices including nameplate designations. Wiring diagrams of all RTU and other system equipment including field device connections shall be included and specific installation wiring responsibilities identified.

Input/output drawings shall indicate terminal numbers and signal identification names.

Complete instrument and control system block diagrams shall show in schematic form the interconnections between major hardware components. The block diagrams shall reflect the total integration of all digital and analog devices in the system. The diagrams shall reference all interconnecting cabling requirements for digital components of the system including any data communication links.

Software submittals shall provide a complete description of the system on a functional level. The software submittal shall cover the detailed control algorithms and process graphic displays that the system supplier has developed through meetings with the NASA COTR. Prior to the software submittal, the software supplier shall meet with the NASA COTR and review/modify functions of all operations to tailor the software to the required application. Specifically, this shall include the configuration of all displays, graphics, and operator interfacing. The function of all software process control and loops shall also be included. This process shall be repeated subsequent to the factory demonstration.

SD-06 Test Reports G

A report of on-site frequency measurements shall be submitted. This report shall include path profiles, including obstructions, potential interference sources (power lines, smoke stacks, radio stations), line of sight availability adjusted for earth curvature and fresnel zone clearance, and path calculations of gains, losses, and fade margin for each path. This report shall also include recommended equipment specifications including frequency bands, antenna types and mounting heights, transmitters, receivers, grounding, equipment interface, physical packaging, and site-specific recommendations, such as aesthetics.

Written reports of a manufacturer's findings of his product during field inspections attesting that the products are installed in accordance with the manufacturer's installation instructions, shop drawings, or other manufacturer's requirements shall be submitted.

SD-08 Manufacturer's Instructions G

Preprinted material describing installation of a product, system, or material, including special notices and material safety data sheets shall be submitted.

SD-10 Operation and Maintenance Data G

Clear, typewritten, easy-to-understand hard cover instruction manuals for daily operation and maintenance of the telemetering system shall be submitted. Specifically, the manuals shall contain explicit instructions and diagrammed procedures for process operations, loop tuning, and systems maintenance. The instruction manuals shall include as a minimum the following information:

1. Photographs and data sheets of major system components
2. Input/Output terminal diagrams
3. Logic and block diagrams
4. Manufacturer-published operation and maintenance instructions on all equipment
5. Description of systems operation
6. Configuration language description
7. Names, addresses, and telephone numbers of local equipment manufacturer representatives for each device in the system
8. List of expendable materials by form, stock, or model number (e.g., paper, magnetic discs, ribbons, etc.)
9. A simple pictorial presentation and description of the system
10. A functional description of all operator interfaces at all levels of monitoring
11. A description of each type of data format

12. A description for each of the operator controls, its task, and method of recognizing a response to operator manipulation. This description shall include all buttons and keyboards.
13. A glossary of terms
14. Separate step-by-step procedure shall be provided for each action to be performed in operating the system. These procedures should include, but not be limited to, the following:
 - a. Start/stop operation
 - b. All software housekeeping or caretaking operations changing data and time, point calibration, point activation, point deactivation, tuning parameter, and setpoint changes.
 - c. Software procedures that are beneficial to the operator to determine that the system is functioning properly.

SD-11 Closeout Submittals

As-built drawings showing the actual location and inlet elevation of each new pipeline at 100 foot intervals and at all changes in direction shall be submitted.

1.2 STORAGE AND HANDLING

Instruments and equipment shall be carefully handled and protected from weather, dust, construction materials, and damage.

PART 2 PRODUCTS

2.1 TELEMETERING SOFTWARE AND HARDWARE

2.1.1 Functional Description

The telemetering system shall monitor the flow rate at each of the three remote metering vaults as indicated on the drawings. The master unit at the main building shall receive the flow signals from each remote vault over the radio channel. The flow signals then will be transmitted from the master unit to the NASA PBS workstation computer for monitoring, trending, and logging functions.

The communications between the remote and the central station shall be over a radio channel operating on a 900 MHZ UHF radio frequency band utilizing the license-free, spread spectrum radios.

The system shall be configurable to provide for minor changes and additions during manufacturing, installation, and commissioning phases, and on-site by the NASA PBS operations personnel.

The system software shall be reconfigurable in the field. It shall be reconfigurable through the use of computer keyboard and fill-in-the-blanks technique. Systems requiring factory assistance or an off-site computer for reconfiguration are not acceptable.

2.1.1.1 Remote Metering Vaults

Telemetry equipment shall be installed at each remote metering vault as

shown on the drawings and shall operate as specified below.

The metering vault shall transmit flow rate signals from the two flow transmitters to the Master Terminal Unit (MTU) using Remote Telemetry Unit (RTU) over radio communications channel.

Electronic trips capable of being redefined through the selected use of software commands at the computer shall be provided for low/high alarm conditions.

The RTU shall transmit a power fail alarm if AC power is not restored within one minute.

The RTU shall transmit the vault flood alarm (future) to the MTU.

Loop power supply for all two-wire transmitters shall be provided at RTU utilizing regulated 24 VDC power supply as required.

2.1.1.2 System Central Station

The system central station shall be located at the main building as indicated on the drawings. It shall include the Master Terminal Unit (MTU) and the NASA PBS workstation computer.

The MTU or the computer HMI shall perform the communication polling functions. The computer shall allow the operators to perform data acquisition functions such as report generation, alarm management, real-time, and historical trending for each flow signal.

The system shall allow the facility's personnel to monitor and to change set points as required. It shall also provide status conditions, alarm conditions, display of trend, and selected loop display. The system shall perform totalizing the recording functions of selected process variables.

The system shall have the capability of storing flow data and shall provide either daily, weekly, or monthly printouts as selected by the operator. Status conditions, display of trends, and selected loop display shall be provided.

The system shall provide for data gathering of analog and digital real-time process signals and manual laboratory inputs, and for logging of flow rate and accumulation of data, averaging maximum and minimum outputs for "on demand," and daily monthly logs. Constants and coefficients for calculations to be performed must be entered manually.

2.1.1.2 Software

The software shall be Outlook by National Instrument or approved equal. The development package shall have provision for 50 input/output points. The package shall include data acquisition functions such as object graphics, real time and historical trending, alarms, and report generation. Modbus I/O driver shall be used in the proposed MTU/radio.

The system supplier shall provide all programming necessary to provide a fully operational system. Software required shall consist of all programs and systems necessary to perform the functions specified.

The Contractor via the supplier shall assume complete responsibility for successful operation of system. All programs shall be completely debugged

and operable prior to the delivery of the system equipment.

All system software shall be supplied on diskettes and shall provide fast system start-up, simple system installation, and ease of building tasks, control schemes, and displays. For added security, the system furnished shall include provisions for copying the contents of main memory to diskettes through the use of single system commands. The diskettes shall then serve as a back-up for reloading the system when needed.

System software shall provide for addition, modification, or deletion of application detail without interruption of the processes.

System parameters (e.g., set points, alarm limits, and loop constraints) shall be enterable or modifiable using the operator's keyboard.

2.1.2.1 Report Generation System

Formatting Reports

The report generation system shall support all required logging and reporting. All logs, reports, and printouts will be free form; that is, the headings and format will be programmed and printed at time of generation. Preprinted sheets are unacceptable. Basic logs, reports, and printouts are described herein to give system supplier a general description of the quantity, complexity, and types. Final format and variables printed shall be developed by the NASA COTR with the system supplier. Any calculations required shall be made at the time of printing. Each page of the report shall have the name of the facility, type of report, time and date the report was prepared, and page number. All logs and summary reports, with the exception of the alarm and equipment status logs, shall be allowed to be initiated manually and cancelled from the central operator's console.

Real Variables Processing

The equipment supplier shall supply real variables to represent process data for which there are analog signal inputs to the system. The system shall sample each of these input signals at its selected scan rates and perform proper conversions and scaling to obtain instantaneous engineering values. These values then to be used to update real-time data on CRT displays, check for alarm conditions, and store for use with average calculations.

Each hour the average of each of the variables shall be calculated and stored along with the maximum and minimum values for the hour, and total values where applicable.

Each day the daily value of each of the variables shall be calculated and stored along with the maximum and minimum values for the day with time of occurrence, and total values where applicable. This data shall be stored for at least 40 days.

Instantaneous values of all process control variable data shall be stored at the required scan rates and are to be available for use by the control algorithm at its run frequency.

Instantaneous values of all variable data shall be stored for at least one hour in resident memory. Individual one-minute averages shall be used for real-time trending. Individual one-hour averages shall be

stored and used in daily reports.

Extracting Historical Data

The system shall be capable of extracting the stored historical data into spreadsheet Excel files via DDE for further analysis and calculations for final report printing. The extraction process shall as a minimum include the following mathematical functions; last value, standard deviation, area under survey, range, average, square root, maximum, minimum, and average for daily, weekly, monthly, and yearly reports. The final format of all reports shall be developed by the NASA COTR and system supplier during shop drawing process.

Historical Data Recording

The system shall provide historical data recording of identified data points. The data file shall be user-selectable as daily, weekly, monthly, or yearly for each point recorded. Each point shall have an individual enable/disable of historical recording. The historical recording shall use a compression deadband technique to reduce the frequency and amount of data recorded when insignificant fluctuation in data occurs. The system shall utilize a preconfigured program template. The template shall allow the user an easy access and manipulation of the following; tag names, start time and date, engineering unit, color, scale, and grid.

2.1.2.2 Alarm System

An alarm system shall be provided which monitors and reports all alarm conditions. Alarms and return-to-normal transition reports from the remote process controllers shall be collected at the operator's console. Upon receipt of these alarm reports, the console shall perform several automatic operations which provide an interface for allowing the operator to interact with these alarm conditions.

2.1.2.3 Real-Time Trending

Real-time trend displays shall plot samples of the selected points in a x-y format. A trend page shall consist of at least four trend plots with each plot using its unique color. The user shall be able to request exact numeric values for any point in the trend by moving an arrow to the point in the graphic.

Trends shall be offered in line, bar, and text form.

Provisions shall be made so that the points and scan frequency shall be assignable by the operator from the display.

All analog signals stored at MTU data base shall be extracted for monitoring and trending at the computer. Minimum, maximum, and average values for hours, daily, or weekly trends shall be provided as required.

2.1.2.4 Historical Trending

Provision shall be made for storing historical data and to recall that data on CRT for historical trending and display purposes.

The capability to average values to permit longer trending periods shall be provided.

A trend page shall consist of four trend plots with each plot using its unique color.

2.1.3 Hardware

One master terminal unit (MTU) including 900 mhz, 1 watt, spread spectrum radio communication equipment, Modbus protocol, NEMA 1 enclosure and accessories shall be used. The unit shall be OMNEX model DX-900MA (tel. 800-663-8806), or PRIBUSAN model RCI-800-RFM (tel. 440-684-0601), or approved equal by TELOG (tel. 216-518-7700). The PRIBUSAN base radio model RCI-SER (with Modbus) shall be acceptable when configured through the computer as a polling master unit.

Two remote terminal units (RTUs) including the 900 mhz, 1 watt, spread spectrum radio equipment, loop power supply, NEMA 4X enclosures and accessories shall be used. The units shall be OMNEX model DX-900MA, or PRIBUSAN model RCI-200, or approved equal by TELOG.

Antenna assembly, feed lines, and solar power equipment (one site only) as shown on the drawings and specified herein.

Data communication, interconnection wiring, and associated devices as required to provide a fully functional system shall be furnished by the Contractor.

2.1.3.1 MTU and RTU Panels

The panels shall be preassembled, prewired, and include all of the necessary controls as specified herein and shown on the drawings. The Contractor shall take full responsibility for unloading the panels and installing them.

Each panel shall consist of a wall-mounted, nonmodular assembly. Access shall be available from the front with access doors to all interior wiring and components.

Wiring shall be general purpose, open type, neatly bundled and laced or installed in plastic wiring troughs. Wire shall be No. 16 AWG minimum with 300 volt, 75°C rated thermoplastic insulation. Wiring shall comply with the latest Ohio Electrical Code. Power and low voltage DC signal wiring shall be routed in separate wiring troughs. Parallel troughs of different systems shall be separated by a minimum of six inches.

All panel wiring to external equipment shall be terminated on screw type terminal strips. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal, etc.). All terminals shall be labeled or otherwise identified for field connections. The terminal strips shall be provided with a minimum of 25 percent spares.

2.1.3.2 UHF Radio Communications Channel

The system shall be suitable for use over a radio communications channel with a minimum transmission power of 1 watt. Operational characteristics shall comply with the FCC requirements. It shall be capable of operating over a radio network containing repeater stations. FM signaling shall be used to minimize the effects of electrical interference. All equipment shall be FCC type acceptable for this application.

2.1.3.3 Antenna (RTUs)

The radio antenna shall be Antennex, 900 MHZ band operating range, 10 dB, directional ("Yagi") antenna or an approved equal with associated U-bolt clamps for required mounting. The antenna shall be properly grounded as required and as recommended by the manufacturer. The antenna shall be located as shown on the drawings. Feed lines shall be Heliac 7/8 inch low loss coaxial cable.

2.1.3.4 Antenna (MTU)

The radio antenna shall be 10 dB, 900 MHZ band operating range "OMNI" directional antenna with a 7/8 inch "Hardline" low loss coaxial cable, Heliac, or similar semi-rigid coaxial cable. Antenna shall be manufactured by Antennex or approved equal. The antenna shall be properly grounded as directed by the manufacturer. The antenna shall be attached to the new radio tower via the use of U-bolt clamps as directed by the manufacturer.

2.1.3.5 Solar Power Equipment

Solar power shall be provided for two RTU sites as shown on the drawings.

The solar power systems shall include solar panels, batteries, charger controller, and a DC/DC converter to provide 24 VDC power for operation of RTU, flow transmitters, and the radio equipment. The solar panels and batteries shall be sized for continuous operation of the telemetering equipment band to flow transmitters for ten consecutive cloudy days. A detailed calculation shall be provided with the submittals to indicate the required system capacity. Solar batteries, chargers, etc. shall be housed in a NEMA 4X enclosure including 1-inch thick fiberglass insulation for the batteries.

2.1.3.6 Lightning/Surge Protection

Lightning/surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation.

All signal lines when they enter or leave a building shall be protected through the use of gas tube surge arresters and Zener diode protectors. These shall be provided at both ends of the signal lines and as close to the instruments as possible. The protectors shall be MCG type DEP or approved equal.

PART 3 EXECUTION

3.1 FIELD STUDIES

Within ten days of contract award the manufacturer of the telemetering system shall perform the path study and on-site RF measurements for all equipment involved in this project. The radios shall be license-free, spread spectrum operating on 900 MHZ band.

The manufacturer shall visit each remote site (total of two) and the base site and conduct a set of RF measurements on-site using sized transmitters and receivers. The manufacturer shall prepare an analysis of the radio frequency paths made using topographical data and the locations of potential interference sources, such as radio station towers, power

transformers, etc. His analysis shall take into account line-of-sight availability, terrain conditions, radio range, and the proposed types and locations of the antennas. In addition to measuring actual field strengths, the radio frequency activity in the proposed frequency band shall be monitored while on-site. Actual readings shall be made with antennas and hardware that are representative of the types recommended in Part 2 - PRODUCTS.

3.2 FABRICATION TESTING

Major subsystems shall be individually tested for function and operation in a staging area in the vendor's factory. The subsystems shall be interconnected as they will be installed at NASA PBS, and testing shall be performed using simulated inputs and outputs to assure subsystem function and compatibility. The vendor shall furnish a certified copy of the results on each subsystem, indicating model and serial numbers, tests performed, and status of equipment after testing.

3.3 INSTALLATION

The telemetering system and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the drawings. It shall be the responsibility of the manufacturer of this system to ensure compatibility with the existing system. If additional equipment or wiring is necessary, it shall be done at no cost to NASA PBS.

3.3.1 Discrepancies

In the event of discovering a discrepancy, the Contractor shall immediately notify the NASA COTR. The Contractor shall not proceed with installation in the area affected by the discrepancy until the discrepancy has been fully resolved.

3.3.2 Manufacturer's Services

The Contractor shall furnish the services of the manufacturer's serviceman, all special tools, calibration equipment, and labor required for checking the installation of all components before power is applied, and placing the software and hardware into operation.

3.3.3 System Calibration and Start-Up

The manufacturer shall provide the initial calibration and start-up of the system by providing factory-trained personnel to perform the following:

1. Supervise the installation and verify the final connections of all signal and power wiring to and from the control system.
2. Perform all hardware calibration and diagnostic tests and make all necessary equipment connections.
3. Perform all configuration system tests including diagnostics.
4. Perform the acceptance test described in paragraph 3.3.4.
5. Test the operation of the Communications, Monitoring System, and Input/Output Subsystem.
6. Verify the displays and functions of the monitoring, trending, and

logging system at the NASA PBS workstation computer.

If the equipment fails to operate in accordance with the specifications and manufacturer's data, corrective measures shall be taken by the Contractor, or the defective equipment shall be removed and replaced with equipment which does meet the specifications.

3.3.4 Acceptance Test

Following final installation and calibration of the telemetering system, the manufacturer shall perform a demonstration of the system's performance. Satisfactory performance shall require the system to perform control functions, monitoring and display functions, alarming, and printout functions for a period of not less than one (1) month of continuous operation. During this demonstration, any system failure or software-related problem shall be corrected and the demonstration resumed. Acceptance of the control system by the NASA COTR shall require that the system operates continuously for a period of one (1) month without non-field or field repairable hardware or software interruption. Substantial completion shall not be awarded until after the manufacturer has successfully completed the above required test.

3.4 COMMISSIONING

3.4.1 Subsystem Commissioning

The Contractor shall place into operation all component subsystems. This operation shall include loading and placing into operation all CPU software and calibration of all system inputs and outputs. Simulation of system inputs and outputs that are not operational during this subsystem commissioning phase shall be allowed, provided that all of these simulated inputs/outputs shall be subsequently verified during the system commissioning operation.

3.4.2 System Commissioning

The Contractor shall calibrate and place into operation the complete system. The validity of all data base information in the system shall be checked and corrected as part of this operation. Calibration of all process control loops external to the equipment being supplied by other equipment suppliers shall be the responsibility of the Contractor prior to system commissioning.

3.5 TRAINING

The manufacturer shall include at the site operator and maintenance training for the NASA PBS operations personnel for (2) two eight-hour days; one day after start-up and one day at a later date after the system has been in operation. The training shall include system operation, reconfiguration of program maintenance, programming procedures for the telemetering system, the input/output subsystem, peripheral devices, troubleshooting, and hands-on instructions utilizing the NASA PBS system.

3.6 GUARANTEE

The complete telemetering system shall be guaranteed to meet or exceed the design requirements of the specifications and drawings.

Equipment, software, and materials which do not achieve design requirements

after installation shall be replaced or modified by the Contractor to attain compliance, at no additional cost to NASA PBS.

All equipment shall be guaranteed for twelve (12) months after field acceptance by the NASA COTR.

-- End of Section --