

## 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 in the text by the basic designation only.

#### AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB14 (1992) Highway Bridges

#### AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01- 103 (1990) Concrete Pipe Installation Manual

#### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.3 (1996) Process Piping

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 14 (1995) Concrete Sewer, Storm Drain, and Culvert Pipe

ASTM C 33 (1997) Concrete Aggregates

ASTM C 76 (1997) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM D 422 (1963; R 1990) Particle- Size Analysis of Soils

ASTM D 698 (1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft- lbf/ ft (600 kN- m/ m))

ASTM D 1140 (1997) Amount of Material in Soils Finer Than the No. 200 (75- Micrometer) Sieve

ASTM D 1556 (1990; R 1996) Density and Unit Weight of Soil in Place by the Sand- Cone Method

ASTM D 1557 (1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft- lbf/ ft (2,700 kN- m/ m))

ASTM D 1586 (1984; R 1992) Penetration Test and Split- Barrel Sampling of Soils

ASTM D 2321	(1989; R 1995) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity- Flow Applications
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2680	(1995; Rev. A) Acrylonitrile- Butadiene- Styrene (ABS) and Poly( Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2922	(1996) Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1996) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3786	(1987) Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method
ASTM D 3839	(1994; Rev. A) Underground Installation of "Fiberglass" (Glass- Fiber Reinforced Thermosetting Resin) Pipe
ASTM D 4253	(1993) Maximum Index Density of Soils Using a Vibratory Table
ASTM D 4254	(1991) Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4318	(1995; Rev. A) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4355	(1992) Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon- Arc Type Apparatus)
ASTM D 4491	(1996) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1996) Grab Breaking Load and Elongation of Geotextiles

ASTM D 4751	(1995) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(1988; R 1996) Determining the Specification Conformance of Geosynthetics
ASTM D 4833	(1988; R 1996) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1998) Structural Welding Code Steel
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AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C300	(1997) Reinforced Concrete Pressure Pipe, Steel- Cylinder Type
AWWA C600	(1993) Installation of Ductile- Iron Water Mains and Their Appurtenances
AWWA M9	(1995) Concrete Pressure Pipe
AWWA M11	(1989) Steel Pipe - A Guide for Design and Installation
AWWA M23	(1980) PVC Pipe - Design and Installation

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A- A- 203	(Rev. C) Paper, Kraft, Untreated
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CORPS OF ENGINEERS (COE)

COE EM- 385- 1- 1	(1996) Safety and Health Requirements Manual
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DEPARTMENT OF AGRICULTURE (DOA)

DOA SSIR	(April 1984) Soil Survey Investigation Report No. 1, Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, Soil Conservation Service
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 2	(1990) Electrical Plastic Tubing (EPT) and Conduit (EPC- 40 and EPC- 80)
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NEMA TC 6 (1990) PVC and ABS Plastic Utilities Duct  
for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30 (1996) Flammable and Combustible Liquids  
Code

NFPA 70 (1999) National Electrical Code

1.2 DEFINITIONS

1.2.1 Backfill

Material used in refilling a cut, trench or other excavation.

1.2.2 Cohesive Materials

Soils classified by ASTM D 2487 as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when fines have a plasticity index greater than zero.

1.2.3 Cohesionless Materials

Soils classified by ASTM D 2487 as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.2.4 Compaction

The process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum density obtained by the test procedure described in ASTM D 1557 for general soil types

1.2.5 Granular Pipe Bedding

A dense, well- graded aggregate mixture of sand, gravel, or crushed stone (mixed individually, in combination with each other, or with suitable binder soil) placed on a subgrade to provide a suitable foundation for pipe. Granular bedding material may also consist of poorly graded sands or gravels where fast draining soil characteristics are desired.

1.2.6 Hard Material

Weathered rock, dense consolidated deposits, or conglomerate materials (excluding man made materials such as concrete) which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal. Material indicated in the soil boring logs as having a standard penetration resistance as determined by ASTM D 1586 between 60 and 600 blows per foot is arbitrarily defined herein as "Hard Material."

1.2.7 In- Situ Soil

Existing in place soil.

### 1.2.8 Lift

A layer (or course) of soil placed on top of subgrade or a previously prepared or placed soil in a fill or backfill.

### 1.2.9 Refill

Material placed in excavation to correct overcut in depth.

### 1.2.10 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe- mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1 cubic yard in volume. Removal of "hard material" will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production. Material identified in the soil boring logs as having a standard penetration resistance as determined by ASTM D 1586 greater than 600 blows per foot is arbitrarily defined herein as "Rock."

### 1.2.11 Topsoil

In natural or undisturbed soil formations, the fine- grained, weathered material on the surface or directly below any loose or partially decomposed organic matter. Topsoil may be a dark- colored, fine, silty, or sandy material with a high content of well decomposed organic matter, often containing traces of the parent rock material. Gradation and material requirements specified herein apply to all topsoil references in this contract. The material shall be representative of productive soils in the vicinity.

### 1.2.12 Unyielding Material

Rock rib, ridge, rock protrusion, or soil with cobbles in the trench bottom requiring a covering of finer grain material or special bedding to avoid bridging in the pipe or conduit.

### 1.2.13 Unsatisfactory Material

In- Situ soil or other material which can be identified as having insufficient strength characteristics or stability to carry intended loads in the trench without excessive consolidation or loss of stability. Also backfill material which contains refuse, frozen material, large rocks, debris, soluble particles, and other material which could damage the pipe or cause the backfill not to compact. Materials classified as PT, OH, or OL by ASTM D 2487 are unsatisfactory.

### 1.2.14 Unstable Material

Material in the trench bottom which lacks firmness to maintain alignment and prevent joints from separating in the pipe, conduit, or appurtenance structure during backfilling. This may be material otherwise identified as satisfactory which has been disturbed or saturated.

## 1.3 SUBMITTALS

### 1.3.1 SD- 12 Field Test Reports

- a. Test for moisture- density relation

b. Density and moisture tests

Submit field test data not listed above sufficiently in advance of construction so as not to delay work.

1.3.1.1 Test for Moisture- Density Relation

Submit 7 days prior to commencing utility excavation.

1.3.1.2 Density and Moisture Tests

Submit within 7 days of test date.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver and store materials in a manner to prevent contamination, segregation, freezing, and other damage. Store synthetic fiber filter fabric to prevent exposure to direct sunlight.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations are as indicated.
- b. No pipes or other man- made obstructions, except those indicated, will be encountered.
- c. The character of the material to be excavated or found in the trench is as indicated. Rock as defined in paragraph entitled "Definitions," will not be encountered.
- d. Ground water elevations indicated are those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction. Historical data indicates that ground water elevations are in excess of 25 feet.
- e. Borrow material, Suitable backfill and bedding material in the quantities required is not available at the project site.
- f. Blasting will not be permitted.

1.6 PROTECTION

1.6.1 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to non- Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power- driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

Provide soil materials as specified below free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, ice, or other deleterious and objectionable materials.

#### 2.1.1 Backfill

Bring trenches to grade indicated on the drawings using material excavated on the site of this project. This material will be considered unclassified and no testing other than for compaction will be required before use as backfill, classified as SC by ASTM D 2487 with a maximum particle size of 3 inches.

#### 2.1.2 Topsoil Material

Salvaged topsoil from stockpile. Prior to spreading, test topsoil, and add necessary soil modifiers to bring material within the ranges specified in Table I. Furnish additional topsoil from approved sources off the site meeting requirements specified in Table I if stockpiled material is insufficient to complete work indicated. Free of subsoil, stumps, rocks larger than 3/4 inch in diameter (with maximum 3 percent retained on 1/4 inch sieve), brush, weeds, toxic substances, and other material or substance detrimental to plant growth. Topsoil shall be a natural, friable soil representative of productive soils in the vicinity. Modify the topsoil provided if necessary to meet the requirements specified in Table I.

TABLE I

<u>DOA SSIR Soil Survey Investigation Report No. 1, Laboratory Test for:</u>	<u>Acceptable Limits</u>
Sand Content	20 - 45 percent by weight
Silt Content	25 - 50 percent by weight
Clay Content	10 - 30 percent by weight
Organic Material (Walkley-Block)	5 percent
pH	5.0 to 7.6
Soluble Salts	600 ppm maximum
Absorption Rate	0.5 inch per hour minimum

2.1.3 Pipe Bedding

TABLE II UTILITY EARTHWORK REFERENCES

<u>PIPE MATERIALS</u>	<u>SOIL SPECIFICATION</u>	<u>REF</u>
a. Polyvinyl Chloride (PVC) Nonpressure Pipe	ASTM D 2321, ASTM D 2321 bedding shall be Class II, SP, Haunching to springline shall be Class II, SP	except
b. Polyvinyl Chloride (PVC) Pressure Pipe	ASTM D 2774, ASTM D 2774 bedding shall be SP and all material surrounding pipe shall have maximum particle size of 1/2 inch.	except

2.2 BURIED WARNING AND IDENTIFICATION TAPE

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

Warning Tape Color Codes

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

2.2.1 Warning Tape for Metallic Piping

Acid and alkali- resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

### 2.2.2 Detectable Warning Tape for Non- Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

### 2.3 DETECTION WIRE FOR NON- METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum diameter of 12 AWG.

## PART 3 - EXECUTION

### 3.1 PROTECTION

#### 3.1.1 Drainage and Dewatering

Plan for and provide the structures, equipment, and construction for the collection and disposal of surface and subsurface water encountered in the course of construction.

##### 3.1.1.1 Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing.

Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

#### 3.1.2 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. (None are anticipated.)

#### 3.1.3 Structures and Surfaces

Protect newly backfilled areas and adjacent structures, slopes, or grades from traffic, erosion settlement, or any other damage. Repair and reestablish damaged or eroded grades and slopes and restore surface construction prior to acceptance.

##### 3.1.3.1 Disposal of Excavated Material

Dispose of excavated material so that it will not obstruct the flow of runoff, endanger a partly finished structure, impair the efficiency or appearance of any facilities, or be detrimental to the completed work.

## 3.2 SURFACE PREPARATION

### 3.2.1 Stockpiling Topsoil

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be stockpiled and used for backfilling. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

### 3.2.2 Cutting Pavement, Curbs, and Gutters

Saw cut with neat, parallel, straight lines one foot wider than trench width on each side of trenches and one foot beyond each edge of pits. When the saw cut is within 2 feet of an existing joint, remove pavement to the existing joint.

## 3.3 GENERAL EXCAVATION AND TRENCHING

Keep excavations free from water while construction is in progress. Notify the Contracting Officer immediately in writing if it becomes necessary to remove rock or hard, unstable, or otherwise unsatisfactory material to a depth greater than indicated. Make trench sides as nearly vertical as practicable except where sloping of sides is allowed. Sides of trenches shall not be sloped from the bottom of the trench up to the elevation of the top of the pipe. Excavate ledge rock, boulders, and other unyielding material to an overdepth at least 6 inches below the bottom of the pipe and appurtenances unless otherwise indicated or specified. Blasting will not be permitted. Overexcavate soft, weak, or wet excavations. At the Contractor's option, the excavations may be cut to an overdepth of not less than 4 inches and refilled to required grade as specified. Grade bottom of trenches accurately to provide uniform bearing and support for each section of pipe on undisturbed soil, or bedding material as indicated or specified at every point along its entire length except for portions where it is necessary to excavate for bell holes and for making proper joints. Dig bell holes and depressions for joints after trench has been graded. Dimension of bell holes shall be as required for properly making the particular type of joint to ensure that the bell does not bear on the bottom of the excavation. Trench dimensions shall be as indicated.

## 3.4 BEDDING

Of materials and depths as indicated for utility lines and utility line structures. Place bedding in 6 inch maximum loose lifts. Provide uniform and continuous support for each section of structure except at bell holes or depressions necessary for making proper joints.

## 3.5 BURIED WARNING AND IDENTIFICATION TAPE

Install tape in accordance with manufacturer's recommendations except as modified herein. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

## 3.6 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe.

### 3.7 BACKFILLING

Construct backfill in two operations (initial and final) as indicated and specified in this section. Place initial backfill in 6 inch maximum loose lifts to one foot above pipe unless otherwise specified. Ensure that initially placed material is tamped firmly under pipe haunches. Bring up evenly on each side and along the full length of the pipe structure. Ensure that no damage is done to the utility or its protective coating. Place the remainder of the backfill (final backfill) in 9 inch maximum loose lifts unless otherwise specified. Compact each loose lift as specified in the paragraph entitled "General Compaction" before placing the next lift. Do not backfill in freezing weather or where the material in the trench is already frozen or is muddy, except as authorized. Provide a minimum cover from final grade of 3 feet for water piping and 3 feet for sewer mains. Where settlements greater than the tolerance allowed herein for grading occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation. Coordinate backfilling with testing of utilities. Testing for the following shall be complete before final backfilling: water distribution and sanitary sewer systems. Provide buried warning and identification tape installed in accordance with the manufacturer's recommendation.

### 3.8 COMPACTION

Use hand- operated, plate- type, vibratory, or other suitable hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes and protective pipe coatings. Compact material in accordance with the following unless otherwise specified. If necessary, alter, change, or modify selected equipment or compaction methods to meet specified compaction requirements.

#### 3.8.1 Compaction of Material in Subcuts or Overexcavations

In rock, compact to 95 percent of ASTM D 1557 maximum density. In soft, weak, or wet soils, tamp refill material to consolidate to density of adjacent material in trench wall. In stable soils, compact to 90 percent of ASTM D 1557 maximum density.

#### 3.8.2 Compaction of Pipe and Conduit Bedding

In rock, compact to 95 percent and in soil, compact to 90 percent of ASTM D 1557 maximum density.

#### 3.8.3 Compaction of Backfill

Compact initial backfill material surrounding pipes, cables, conduits, or ducts, to 90 percent of ASTM D 1557 maximum density except where bedding and backfill are the same material. Where bedding and backfill are the same material, compact initial backfill to the density of the bedding. Under areas to be seeded or sodded, compact succeeding layers of final backfill to 85 percent of ASTM D 1557 maximum density. Compact succeeding layers of final backfill as specified under Section 02301, "Earthwork for Structures and Pavements."

#### 3.8.4 Compaction for Structures and Pavements

Place final backfill in 6 inch maximum loose lifts. If a vibratory roller is used for compaction of final backfill, the lift thickness can be increased to 9 inches. Compact all backfill surrounding pipes, ducts, conduits, and other structures to 90 percent of ASTM D 1557 maximum density except compact the top 12 inches of subgrade to 95 percent of ASTM D 1557 maximum density. Backfill to permit the rolling and compacting of the completed excavation with the adjoining material, providing the specified density necessary to enable paving of the area immediately after backfilling has been completed.

### 3.9 FINISH OPERATIONS

#### 3.9.1 Grading

Finish to grades indicated within one-tenth of a foot. Grade areas to drain water away from structures. Grade existing grades that are to remain but have been disturbed by the Contractor's operations.

#### 3.9.2 Disposition of Surplus Material

Surplus or other soil material not required or suitable for filling, backfilling, or grading shall be removed from the site. Comply with requirements of Section 01575, "Temporary Environmental Controls."

#### 3.9.3 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur and as required in Section 01575, "Temporary Environmental Controls." Repair or reestablish damaged grades, elevations, or slopes.

#### 3.9.4 Pavement Repair

Repair pavement, curbs, and gutters as indicated. Do not repair pavement until trench or pit has been backfilled and compacted as specified herein. Provide a temporary road surface over backfilled portion until permanent pavement is repaired. Remove and dispose of temporary road surface material when permanent pavement is placed. As a minimum, maintain one-way traffic on roads and streets crossed by trenches.

### 3.10 FIELD QUALITY CONTROL

Test bedding, backfill for conformance to specified requirements. Test backfill to be used under roads and paved areas for conformance to special requirements. Test bedding and backfill for moisture-density relations in accordance with ASTM D 1557 as specified herein. Perform at least one of each of the required tests for each material provided. Perform sufficiently in advance of construction so as not to delay work. Provide additional tests as specified above for each change of source. Perform final tests on topsoil to ensure adjustment of parameters into the ranges specified. Perform density and moisture tests in randomly selected locations and in accordance with ASTM D 1556 as follows:

- a. Bedding and backfill in trenches: One test per 100 linear feet in each lift.
- b. Appurtenance structures: One test per 100 square feet or fraction thereof in each lift.

END OF SECTION