

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE GENERAL SPECIFICATIONS**

**SUBSURFACE DRAIN**

(ft)  
CODE 606

**1. Scope**

*Work shall consist of furnishing and installing a conduit with applicable filter material beneath the ground surface to a specified grade.*

**2. Location**

*The planned location of the subsurface drain shall be as shown on furnished drawings or as staked in the field with controlled elevations.*

**3. Public and private utilities**

*Utilities are defined to be overhead and underground power or communication lines and pipelines. All utilities discovered to be in the work area are shown on the drawings or sketches. However, the absence of indicators on the drawings or sketches for utilities does not assure that additional utilities do not exist in the work area. The contractor is alerted to conduct his/her own search and discovery for utilities in order to lessen or avoid potential damages. The owner/operator shall complete TX-ENG-80, UTILITIES INVENTORY prior to layout or any ground disturbance and return it to an NRCS representative.*

**4. Materials**

The following specifications pertain to products currently acceptable for use as subsurface drains. These specifications are also to be applied in determining the quality of materials referenced by other standards:

*a. Subsurface Drains*

Type	Specification
<i>Plastic</i>	
Corrugated polyethylene (PE) tubing and fittings 3-6 in.	ASTM-F-405 <sup>1</sup>
Corrugated polyethylene (PE) tubing and fittings 8-24 in.	ASTM-F-667 <sup>1</sup>
Corrugated polyvinyl chloride (PVC) tubing and compatible fittings	ASTM-F-800 <sup>1</sup>
Polyvinyl chloride (PVC) corrugated sewer pipe with a smooth interior and fittings 4-8	ASTM-F-949 <sup>1</sup>
Polyvinyl chloride (PVC) sewer pipe and fittings	ASTM-D-2729 <sup>1</sup>
Polyvinyl chloride (PVC) pipe	ASTM-D-3033 <sup>1</sup> or D-3034 type PSM or PSP
<i>Clay</i>	
Clay drain tile	ASTM-C-4 <sup>1</sup>
Clay drain tile, perforated	ASTM-C-498 <sup>1</sup>

Conservation practice General Specifications are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

Clay pipe, perforated, standard and extra strength	ASTM-C-700 <sup>1</sup>
Clay pipe, testing	ASTM-C-301 <sup>1</sup>
Concrete	
Concrete drain tile	ASTM-C-412 <sup>1</sup>
Concrete pipe for irrigation or drainage	ASTM-C-118 <sup>1</sup>
Concrete pipe or tile, determining physical properties of	ASTM-C-497 <sup>1</sup>
Concrete sewer, storm drain, and culvert pipe	ASTM-C-14 <sup>1</sup>
Reinforced concrete culvert, storm drain, and sewer pipe	ASTM-C-76 <sup>1</sup>
Perforated concrete pipe	ASTM-C-444 <sup>1</sup>
Portland cement	ASTM-C-150 <sup>1</sup>
Other	
Styrene rubber plastic drain pipe and fittings	ASTM-D-2852 <sup>1</sup>
Pipe, corrugated (aluminum alloy)	Federal Specification WW-P-402 <sup>2</sup>
Pipe, corrugated (iron or steel, zinc coated)	Federal Specification WW-P-405 <sup>2</sup>
<i>Bituminized fiber, perforated drainage pipe</i>	<i>Federal Specification SS-P-1540a<sup>2</sup></i>
<i>Homogeneous perforated bituminized fiber pipe for general drainage</i>	<i>ASTM D-2311<sup>1</sup></i>
<i>Laminated-wall, bituminized fiber perforated pipe for agricultural land and general drainage</i>	<i>ASTM D-2417<sup>1</sup></i>

<sup>1</sup> Specifications can be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103

<sup>2</sup> Specifications can be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

*Additional Applicable Testing and Material Specifications:*

*Concrete pipe used for subsurface drains shall be constructed with ASTM C-150 Type II or Type V portland cement.*

*Homogeneous bituminized fiber pipe, testing - ASTM D-2314*

*Laminated-wall bituminized fiber pipe, physical testing of - ASTM D-2315*

*When requested, pipe constructed of the above fiber and plastic materials shall be certified by the manufacturer for compliance with the applicable specifications.*

*Subsurface drain tile or pipe of material other than that listed above shall meet material and installation specifications as approved by the State Conservation Engineer.*

Where perforated conduit is required, the water inlet area shall be at least 1 sq.in./ft of conduit length. Round perforations shall not exceed 3/16-in. in diameter except where filters, envelopes, or other protection is provided or for organic soils, where a maximum hole diameter of ½ in. may be used. Slotted perforations shall not exceed 1/8 in. in width.

*b. Filters and Filter Material*

*All subsurface drains shall be installed with a suitable filter material to prevent excessive amounts of sediment from entering the conduit and to facilitate the collection of groundwater and its passage into the drain.*

*A sand-gravel filter material shall be within the gradation required by the base material in the trench. All of the filter material shall pass the 1 ½ -inch sieve, 90 to 100 percent shall pass the ¾-inch sieve, and not more than 10 percent shall pass the No.60 sieve. Not less than 3 inches of filter material shall be used for sand-gravel filters. A recommended method of installation is to place filter material to a depth of 3 inches under the drain, and cover the drain and filter with a sheet of plastic not less than 6 millimeters thickness.*

*Fiberglass filter material shall be the long-fiber type and manufactured from borosilicate type glass. The fibers shall be of variable size with some larger fibers intertwined in the mat in a random manner. The material shall have a minimum nominal thickness of 1 inch and density of one pound per cubic foot.*

*When used on subsurface concrete drain tile, the fiberglass material shall be wrapped at least around each tile joint and overlapped and secured in a manner which will prohibit filter from being displaced during backfill operations. As a minimum, sides of the filter material shall extend on each side of tile joint approximately 3 inches.*

*Fiberglass filter material shall be laid in a continuous strip over slotted or perforated pipe in a manner that will leave the fiberglass concentric to the pipe and covering the slots or perforations so as to prohibit soil from intruding between the fiberglass and the slotted or perforated portion of pipe. Width of the fiberglass filter strip shall be at least 8 inches for 4-inch diameter slotted or perforated pipe and 10 inches for 5- and 6-inch diameter pipe.*

*Other artificial prefabricated filter materials such as spun bonded nylon fabric, and plastic filter cloth are acceptable provided the opening sizes, strength, durability, and permeability are adequate to provide constant filtering action in the soil material involved and to protect subsurface drain operation throughout the expected life of the system.*

*c. Envelopes and Envelope Material*

Envelopes shall be used around subsurface drains when specified for proper bedding of conduit, or where necessary to improve the characteristics of flow of ground water into the conduit. If a sand-gravel filter is specified, it shall be of clean, hard durable material and of the gradation specified.

When sand-gravel envelopes are used they will be of clean, hard, durable material with less than 5 percent passing the No. 200 sieve, not more than 30 percent passing the No. 60 sieve, and with a maximum size of 1 ½ in. ASTM-C-33 fine aggregate for concrete will meet these requirements.

## **5. INSTALLATION**

### **Inspecting and handling materials**

Material for subsurface drains shall be carefully inspected before the drains are installed. *Bituminized fiber and plastic* pipe and tubing shall be protected from hazard-causing deformation or warping. Plastic pipe and tubing with physical imperfections shall not be installed. A damaged section shall be removed and a suitable joint made connecting the retained sections. Clay and concrete tile shall be checked for damage from freezing and thawing before it is installed. All material shall be satisfactory for its intended use and shall meet applicable specifications and requirements.

### ***Method of installation Restriction***

*The trenchless method for installation of subsurface drains will not be permitted in the Lower Rio Grande Valley of Texas. The NRCS, therewith, will not render technical assistance upon or certify the technical adequacy for federal cost sharing on subsurface drains installed by the trenchless method in this designated area.*

## **6. FOUNDATION REQUIREMENT**

*Soft or yielding foundations shall be stabilized where required and lines protected from settlement by adding gravel or other material to the trench, placing the conduit on plank or other rigid supports, or using long sections of perforated or watertight pipe.*

## **7. PLACEMENT OF DRAINS, FILTERS, AND MATERIALS**

*Subsurface drains shall be laid to the line and grade shown on the drawings or as staked in the field. No reversals in grade of the conduit shall be permitted. Drains shall be covered with approved blinding, envelope, or filter material to a depth of not less than 3 inches over the top of the drain.*

## **8. SPECIFICATIONS—FLEXIBLE CONDUIT**

### **I. Flexible Conduit special requirements**

All conduits shall be laid to line and grade in such a way that the sidewalls are continuously and uniformly supported with suitable bedding material. Such material shall be properly placed and compacted to provide lateral restraint against deflection and to protect the conduit against collapse during backfilling.

### **II. Trenching**

Trench widths must be adequate for proper installation of the conduit, allow proper joining of sections, and allow proper placement of filter, envelope, or blinding materials. The trench bottom shall be constructed to proper grade before placement of the conduit.

*Where rock is encountered the trench will be over-excavated a minimum of 6 in. and refilled to proper grade with a suitable bedding material. Where the conduit is to be laid in a rock trench, or where rock is exposed at the bottom of the trench, the rock shall be over-excavated a minimum of 6 in below grad. The trench shall then be refilled, to proper grade with a suitable bedding material compacted as shown in the construction details. When completed, the conduit shall be not less than 2 inches from rock.*

Provisions for safety during trenching operations shall be in compliance with the applicable safety and health regulations for construction.

### **III. Bedding**

The trench bottom shall be smooth and free of clods and loose or exposed rock. Where a gravel envelope is not specified, the bottom of the trench shall be shaped to conform to the pipe. The groove may be semi-circular, trapezoidal, or a 90 degrees "V"-shape (90 degree "V" suitable for 3-8 in. only) and shall be of such dimensions that the bottom quarter of the pipe is below the contact points of the groove.

In unstable soils a firm foundation shall be provided by over-excavation and backfilling with processed stone or gravel, suitably graded so as to act as a mat into which unstable soil will not penetrate.

*One of the following methods of bedding shall be used when the drainage conduit is corrugated plastic drainage tubing:*

- a. *Artificial prefabricated filters other than fiberglass to be used:*

*The bottom of the excavated trench shall be shaped to conform approximately to the shape of the conduit and*

*the conduit shall be laid in this groove. The groove may be semicircular or trapezoidal-shaped and shall be of such dimensions that the bottom 120 degrees of the conduit is supported by undisturbed soil. Blinding and backfilling operations can be in the conventional manner using soil from the sides of the trench and excavated material.*

*b. Fiberglass filter to be used:*

*The trench bottom shall be shaped to form a groove in its center. This groove shall conform to the full width of the tubing. The groove may be semicircular or trapezoidal-shaped, and shall be of such dimensions that the bottom 120 degrees of the conduit is supported by undisturbed soil. A sheet or mat of filter material shall be centered over the groove. After the filter is in place, the tube shall be placed in the groove, pressing the filter into the groove between the tube and the base material. After the tubing is in place, a sheet of filter material or of plastic shall be placed over the top of the tube and the trench completely filled with friable material to a depth of not less than 3 inches over the top of the tube.*

*c. Sand-Gravel filter to be used -conventional trench:*

*The trench shall be over-excavated to a depth of 3 inches and a 3-inch layer of sand-gravel filter material shall be placed in the bottom of the trench. The tube shall be placed and centered on this layer of filter material while additional filter material is placed around the tubing, completely filling the trench to depth of 3 inches over the top of the tube; or a sheet of plastic, not less than 6 millimeters thick, shall be placed over the tube and filter and the trench completely filled with friable material to a depth of 3 inches over the top of the tube. In narrow trenches, the latter method may be needed to meet the minimum requirement for thickness of sand-gravel filters of 3 inches.*

#### **IV. Placement**

Conduit will be placed in such a way that maximum stretch does not exceed 5 percent.

Fittings shall be installed in accordance with instructions furnished by the manufacturers. Couplers are recommended at all joints and fittings, at all changes in direction (where the centerline radius is less than three times tubing diameter), at changes in diameter, and at junction with another line.

Caps are needed at the ends of lines. Caps of concrete or other durable material shall be installed at the upper end of each subsurface drain line unless the line is connected to a structure at that point. All fittings shall be compatible with the tubing. Where certain fittings are not available, handcut holes are acceptable provided care is taken when making the connection not to create a means of obstructing flow, catching debris, or allowing soil to enter the line. Place selected bedding material, containing no hard object larger than 1 ½ in. in diameter in the trench to a minimum depth of 6 in. over the conduit. The conduit will be held in place mechanically until secured by blinding.

#### **V. Backfilling**

Place earth backfill material so that displacement or deflection of the subsurface drain conduit will not occur, and that the filter and bedding material, after backfilling, will meet the requirements of the plans and specifications. This is preferably on an angle, so the material flows down the front slope. Avoid large stones, frozen material, and dry clods that cause concentrated point loads on the tubing. The trench should be backfilled as soon as practical. When installing the tubing on a hot day, backfilling should be delayed until tubing temperature cools to the soil temperature.

### **9. SPECIFICATIONS—CLAY AND CONCRETE TILE**

#### **I. Clay and concrete drain tile special requirements**

If clay tile will not be exposed to freezing and thawing before or during installation and if the average frost depth will be less than 18 in., the freezing and thawing and adsorption tests may be modified or

waived.

The use of concrete tile in acid and sulfate soils shall be in accordance with the following limitations:

Acid soils:

Class of tile	Lower permissible limits of pH values	
	Organic and sandy soils	Medium and heavy-textured soils
ASTM-C-412		
Standard quality	6.5	6.0
Extra quality	6.0	5.5
Heavy duty extra quality	6.0	5.5
Special quality	5.5	5.0
ASTM-C-14, C-118, C-444	5.5	5.0

NOTE: Figures represent the lowest reading of pH values for soil or soil water at subsurface drain depth.

Sulfate soils:

Type of tile and cement (minimum)		Permissible maximum limit of sulfates, singly or in combination ppm
Tile:	ASTM-C-412 Special quality C-14, C-118, C-444	7,000
Cement:	ASTM-C-150, Type V	
Tile:	ASTM-C-412 Extra quality, Heavy-duty extra quality C-14, C-118, C-444	3,000
Cement:	ASTM-C-150, Type II or V	
Tile:	ASTM-C-412 Standard quality C-14, C-118, C-444	1,000
Cement:	ASTM-C-150, any type	

NOTE: Figures represent the highest reading of sulfates for soil or soil water at subsurface drain depth.

Bell and spigot, tongue and groove, and other types of pipe that meet the strength, absorption, and other requirements of clay or concrete tile as specified in the preceding paragraphs, except for minor imperfections in the bell, the spigot tongue, or the groove, and ordinarily classed by the industry as "seconds," may be used for drainage conduits, provided that the pipe is otherwise adequate for the job.

## II. Trenching

Trench widths must be adequate for proper installation of the conduit; must allow proper joining of sections; and must allow proper placement of filter, envelope, or blinding materials. The trench width will be a minimum of 3 to 6 in. on both sides of tubing. The trench bottom shall be constructed to proper grade and shape before placement of the conduit.

Where rock is encountered the trench will be overexcavated a minimum of 6 in. and refilled to proper grade with a suitable bedding material.

Provisions for safety during trenching operations shall be in compliance with the applicable safety and health regulations for construction.

## III. Bedding

If unstable soil conditions are encountered, the trench bottom must be stabilized before placement

of conduit. Where necessary the unstable material will be removed and replaced with sand-gravel or a similar suitable stabilizing material. Where an envelope is not specified, the bottom of the trench shall be shaped to ensure good alignment of the conduit.

Where the conduit is to be laid in a rock trench, or where rock is exposed at the bottom of the trench, the rock shall be removed below grade enough that the trench may be backfilled, compacted, and bedded; and when completed, the conduit shall be a minimum of 6 in. from rock.

#### **IV. Placement**

All conduits shall be laid to line and grade and covered with the specified blinding, envelope, or filter material to a depth of not less than 3 in. around the drain. Blinding material shall contain no hard objects larger than 1 ½ in. in diameter.

When a sand-gravel filter is specified, all openings in the conduit must be covered with at least 3 in. or filter material except that the top of the conduit and the side filter material may be covered with a sheet of plastic or similar impervious material. The impervious sheet will be covered with at least 3 in. of blinding material.

Joints between drain tile shall not exceed 1/8 in. except in sandy soils, where the closest possible fit must be obtained, and in organic soils where some of the more fibrous types make it desirable to increase slightly the space between tile.

#### **V. Backfill**

Backfill will be placed in such a manner as to avoid displacement of the conduit. Backfill should be moved into the trench at an angle so that material slows down the front slope of previously placed material. Backfill shall not contain frozen material, stones, clods, or objects large enough to damage the conduit. The trench should be backfilled as soon as possible after blinding.

### **10. AUXILIARY STRUCTURES AND SUBSURFACE DRAIN PROTECTION**

*The outlet shall be protected against erosion and undermining of the subsurface drain, against damaging periods of submergence, and against entry of rodents or other animals into the drain. A continuous section of pipe, minimum length of 8 feet, without open joints or perforations, shall be used at the outlet end of the line and shall outlet above the normal elevation of low flow in the outlet ditch.*

*Watertight conduit strong enough to withstand the loads upon it shall be used where subsurface drains cross under irrigation canals or other ditches. Conduits under roadways shall be designed and installed to withstand the expected loads.*

*Junction boxes shall be used where more than two main lines join.*

*When surface water is to be admitted to subsurface drains, inlets shall be designed and installed to exclude debris and prevent sediment from entering the conduit.*

### **11. CONSTRUCTION**

*Construction operation shall be carried out in such a manner that erosion and air and water pollution will be minimized.*

### **12. MEASUREMENT**

*The amount of subsurface drain completed as specified will be determined by measuring the length in feet.*

### **13. CERTIFICATION AND GUARANTEE**

*All materials shall conform to these minimum requirements and to tests prescribed in the applicable ASTM Specification.*

*The acceptance of materials used will be by one of the following methods:*

- a. Onsite approval based on properly marked material showing compliance with the applicable ASTM Specification.*
- b. When conditions warrant, the State Conservation Engineer may elect to request the manufacturer to furnish material test data and written certification of compliance with applicable ASTM Specifications, including a description of the method to be used in identifying the certified material.*

*The installing contractor shall certify to the purchaser that the materials and installation comply with the requirements of these specifications. He/she shall furnish the purchaser a written guarantee against defective workmanship and materials to cover a period of not less than one year. He/she shall record on the guarantee the manufacturer's name and markings of the pipe material used.*

*The installing contractor shall furnish the NRCS a copy of his/her certification and guarantee, which will be made a part of the supporting records of the subsurface drain.*

#### **14. CONSTRUCTION DETAILS**