

Subsurface Drain Specifications

INSTALLATION

Inspecting and handling materials.

Material for subsurface drains shall be carefully inspected before the drains are installed. 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.

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:

Type	Specification
<i>Plastic</i>	
Corrugated polyethylene (PE) tubing and fittings 3-6 in.	ASTM-F-405 ¹
Corrugated polyethylene (PE) tubing and fittings 8-24 in.	ASTM-F-667 ¹
Corrugated polyvinyl chloride (PVC) tubing and compatible fittings	ASTM-F-800 ¹
Polyvinyl chloride (PVC) corrugated sewer pipe with a smooth interior and fittings 4-8 in.	ASTM-F-949 ¹
Polyvinyl chloride (PVC)	ASTM-D-2729 ¹

sewer pipe and fittings	
Polyvinyl chloride (PVC) pipe	ASTM-D-3033 ¹ or D-3034 type PSM or PSP
<i>Clay</i>	
Clay drain tile	ASTM-C-4 ¹
Clay drain tile, perforated	ASTM-C-498 ¹
Clay pipe, perforated, standard and extra strength	ASTM-C-700 ¹
Clay pipe, testing	ASTM-C-301 ¹
<i>Concrete</i>	
Concrete drain tile	ASTM-C-4 ¹
Concrete pipe for irrigation or drainage	ASTM-C-118 ¹
Concrete pipe or tile, determining physical properties of	ASTM-C-497 ¹
Concrete sewer, storm drain, and culvert pipe	ASTM-C-14 ¹
Reinforced concrete culvert, storm drain, and sewer pipe	ASTM-C-444 ¹
Perforated concrete pipe	ASTM-C-76 ¹
Portland cement	ASTM-C-150 ¹
<i>Other</i>	
Styrene rubber plastic drain pipe and fittings	ASTM-D-2852 ¹
Pipe, corrugated (aluminum alloy)	Federal Specification WW-P-402 ²
Pipe, corrugated (iron or steel, zinc Federal coated)	Specification WW-P-405 ²

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

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

General

The installing contractor shall certify that the installation complies with the requirements of these specifications. The

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contractor shall also name the source of materials.

Conduit perforations special requirements

Where perforated conduit is required, the water inlet area shall be at least 1 in.²/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.

SPECIFICATIONS—FLEXIBLE CONDUIT

I. General requirements

All conduits shall be laid to line and grade in such a way that the side walls 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 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. Plow installation

Plow installation has been satisfactorily used in many situations. Special care needs to be exercised relative to grade control and bedding conditions.

IV. 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 overexcavation and backfilling with processed stone or gravel, suitably graded so as to act as a mat into which unstable soil will not penetrate.

V. Filters and envelopes

If a sand-gravel filter is specified, it shall be 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.

VI. 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. 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.

VII. Backfilling

Place backfill material so that displacement or deflection of the conduit will not occur. 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.

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
<i>ASTM-C-412</i>		
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
<i>ASTM-C-14, C-118, C-444</i>	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
		<i>ppm</i>
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. Filters and envelopes

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.

V. 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. of 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.

VI. 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.

PLANNING CONSIDERATIONS FOR WATER QUANTITY AND QUALITY

Quantity

1. Effects on the water budget.
2. Effects on baseflow and runoff to water uses and users.
3. Effects on ground water recharge.
4. The volume of soil water needed to improve plant growth.

Quality

1. Effects on the delivery of sediment and dissolved and sediment-attached
2. Effect of changes in the delivery of dissolved salts, such as nitrates, on downstream water uses and users.
3. In areas of ground water recharge, changes in the delivery of dissolved substances to the aquifer.
4. Effect on downstream water temperatures.
5. Effects on the visual quality of downstream water.

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