

SECTION 948
MISCELLANEOUS TYPES OF PIPE

948-1 Polyvinyl-Chloride Pipe, or Acrylonitrile-Butadiene-Styrene Plastics Pipe.

948-1.1 For Bridge Drains: Polyvinyl-chloride pipe, for use in bridge drains which will be exposed shall conform to the requirements of ASTM D-1785, for Type II, Grade 1, Schedule 40 PVC pipe. For the portion of bridge drains encased in concrete, the pipe may be as specified in 948-1.4.

948-1.2 Pressure Pipe: Pressure pipe for direct burial under pavement shall conform to the requirements of ASTM D-1785, for Type I, Grade I, Schedule 40, for sizes up to and including 2 1/2 inches, and Schedule 80 for sizes up to 4 inches. Pressure pipe 4 inches in diameter and larger shall conform to the requirements of AWWA C900-75, DR18, and ASTM D-1785, Type I, Grade I or other types as may be specifically called for in the plans or special provisions.

948-1.3 Pipe Marking: All polyvinyl-chloride pipe shall be marked as required by Article 8 of ASTM D-1785, and acceptance of the pipe may be based on this data.

948-1.4 Nonpressure Pipe: Polyvinyl-chloride pipe and Acrylonitrile-butadiene-styrene pipe, intended for direct-burial or concrete encasement, shall meet the following requirements:

(a) PVC Pipe: ASTM D-3034, SDR-35, or ASTM F-949, profile wall without perforations.

(b) ABS Pipe: ASTM D-2680.

The manufacturer of the PVC or ABS pipe shall furnish to the Engineer six copies of mill analysis covering chemical and physical test results.

948-1.5 Underdrain: Polyvinyl-chloride pipe for use as underdrain shall conform to the requirements of ASTM F-758 or ASTM F-949. Also, PVC underdrain manufactured from PVC pipe meeting ASTM D-3034, perforated in accordance with the perforation requirements given in AASHTO M-36 or AASHTO M-196 will be permitted.

948-1.6 Edgedrain: Polyvinyl-chloride pipe for use as edgedrain shall conform to the requirements of ASTM F-758, ASTM F-949 or ASTM D-3034 pipe shall be perforated in accordance with the perforation requirements given in AASHTO M-36 or AASHTO M-196. Additional perforations will be required as indicated in the Design Standards, Index No. 286 for pipes designated under ASTM F-758 and ASTM D-3034. Polyvinyl chloride pipe intended for direct burial in asphalt shall meet the following requirements:

(a) ASTM D-3034, SDR-35, or ASTM F-949

(b) NEMA TC-2 (pipe material and compounds) and NEMA TC-3 (pipe fittings) for PVC (90°C electrical conduit pipe) NEMA ECP-40 and NEMA ECP-80. Underwriter Laboratory Specifications referenced under NEMA specifications for electrical conductivity are not required.

(c) Pipe shall withstand asphalt placement temperatures specified without permanent deformation.

(d) Perforations shall be in accordance with AASHTO M-36 or AASHTO M-196.

948-1.7 Polyvinyl Chloride (PVC) Pipe (12 to 36 Inches): Polyvinyl Chloride (PVC) Pipe for side drain, cross drain, storm drain and other specified applications shall conform to AASHTO M-278 for smooth wall PVC pipe or ASTM F-949 for PVC ribbed pipe. Mitered end

sections are not to be constructed of polyvinyl chloride. Use only concrete or metal mitered end sections as indicated in the Design Standards.

Provide certification of the actual mean diameter of pipe shipped to the project. Include in the certification the minimum and maximum diameters used to certify the actual mean diameter. The certification shall be attested to by a person having legal authority to bind the manufacturing company.

Ensure that the pipe joints have been tested at the plant hydrostatically at the specified pressure using test methods in ASTM D-3212 and witnessed by the Engineer.

948-2 Corrugated Polyethylene Tubing and Pipe.

948-2.1 General: For underdrain, Corrugated Polyethylene Tubing and fittings shall meet the requirements of AASHTO M-252. For edgedrain, Corrugated Polyethylene Tubing and fittings shall meet the requirements of AASHTO M-252, except as modified in 948-2.2. For storm drain side drain, french drain and cross drain corrugated Polyethylene Pipe shall meet the requirements of AASHTO M-294 and 948-2.3.2.

The tubing or pipe shall not be left exposed to sunlight for periods exceeding the manufacturer’s recommendation.

948-2.2 Edgedrain (4 to 10 inches): The requirements for Edgedrain as specified in AASHTO M-252 are modified as follows:

(a) Coiling of tubing 6 inches in diameter or greater is not permitted. Tubing shall have a minimum pipe stiffness of 46 psi at 5% deflection.

948-2.3 Corrugated Polyethylene Pipe (12 to 60 inches):

948-2.3.1 General: Class I corrugated Polyethylene Pipe used for side drain, storm and cross drain or french drain shall meet the requirements of AASHTO M-294. Class II Corrugated Pipe shall meet the requirements of AASHTO M-294 and the additional requirements as specified herein. Corrugations may only be annular. Ensure that pipe resin conforms to ASTM D-3350 minimum cell classification 435400C except that cell class 435400E may be used if the combination of color and UV stabilizer provides the same or better UV protection than that of resin cell class 435400C. Mitered end sections are not to be constructed of polyethylene. Use only concrete or metal mitered end sections as indicated in the Design Standards.

Provide certification of the actual mean diameter of pipe shipped to the project. Include in the certification the minimum and maximum diameters used to certify the actual mean diameter. The certification shall be attested to by a person having legal authority to bind the manufacturing company.

Ensure that the pipe joints have been tested at the plant hydrostatically at the specified pressure using test methods in ASTM D-3212 and witnessed by the Engineer.

Ensure that each shipment of products to the job site includes a list of products and each product has an affixed legible stamp mark of the plant, indicating its compliance with the requirements of the plant’s Department approved Quality Control Plan and Contract Documents.

948-2.3.2 Additional Requirements for Class II Polyethylene Pipe: Meet the following requirements:

Table 1
Stress Crack Resistance of Pipes

Table 1

Pipe Location	Test Method	Test Conditions	Requirement
Pipe Liner	FM 5-572, Procedure A	10% Igepal solution at 122°F and 600 psi applied stress, 5 replicates	Average failure time of the pipe liner shall be ≥ 18 hours, no single value shall be less than 13 hours.
Pipe Corrugation ¹ , (molded plaque)	ASTM F-2136	10% Igepal solution at 122°F and 600 psi applied stress, 5 replicates	Average failure time shall be ≥ 24 hours, no single value shall be less than 17 hours.
Junction	FM 5-572, Procedure B and FM 5-573	Full Test ^{2,3} : Test temperature 176°F and applied stresses of 650 and 450 psi. Test temperature 158°F and applied stress of 650 psi; 5 replicates at each test condition	Determine failure time at 500 psi at 73.4°F ≥ 100 years (95% lower confidence) using 15 failure time values ⁴ . The tests for each condition can be terminated at duration equal to or greater than the following criteria: 110 hr at 176°F 650psi 430 hr at 176°F 450 psi 500 hr at 158°F 650 psi
		Single Test ⁵ : Test temperature 176°F and applied stress of 650 psi.; 5 replicates	The average failure time must be equal to or greater than 110 hr
Longitudinal Profiles ⁶	FM 5-572, Procedure C, and FM 5-573	Full Test ^{2,3} : Test temperature 176°F and applied stresses of 650 and 450 psi. Test temperature 158°F at applied stress of 650 psi; 5 replicates at each test condition	Determine failure time at 500 psi at 73.4°F ≥ 100 years (95% lower confidence) using 15 failure time values ⁴ . The tests for each condition can be terminated at duration equal to or greater than the following criteria: 110 hr at 176°F 650psi 430 hr at 176°F 450 psi 500 hr at 158°F 650 psi
		Single Test ⁵ : Test temperature 176°F and applied stress of 650 psi.; 5 replicates	The average failure time must be equal to or greater than 110 hr
Oxidation Resistance of Pipes			
Pipe Location	Test Method	Test Conditions	Requirement

Liner and/or Crown ⁷	OIT Test (ASTM D-3895)	2 replicates (to determine initial OIT value) on the as manufactured (not incubated) pipe.	25 minutes, minimum
Liner and/or Crown ⁷	Incubation test FM 5-574 and OIT test (ASTM D-3895)	Three samples for incubation of 195 days at 176°F ⁸ and applied stress of 250 psi. One OIT test per each sample	Average of 3 minutes ^{9, 10} (no values shall be less than 2 minutes)
Liner and/or Crown ⁷	MI test (ASTM D-1238 at 190°C/2.16 Kg)	2 replicates on the as manufactured (not incubated) pipe.	< 0.4 g/10 minutes
Liner and/or Crown ⁷	Incubation test FM 5-574 and MI test (ASTM D-1238 at 190°C/2.16 Kg)	2 replicates on the three aged sampled after incubation of 195 days at 176°F ⁸ and applied stress of 250 psi	MI Retained Value ^{10, 11, 12} shall be greater than 80% and less than 120%.

Note: FM = Florida Method of Test. 1 Required only when the resin used in the corrugation is different than that of the liner.
2 A higher test temperature (194° F) may be used if supporting test data acceptable to the State Materials Engineer is submitted and approved in writing.
3 Full test shall be performed on alternative pipe diameter of pipe based on wall profile design, raw material cell classification, and manufacturing process. Full test must be performed on maximum and minimum pipe diameters within a manufacturing process.
4 Computer program to predict the 100 year SCR with 95% lower confidence can be obtained from FDOT.
5 Single test for the junction and longitudinal profile may be used on alternating pipe sizes within a manufacturing process. Single point tests may not be used on maximum and minimum pipe sizes within a manufacturing process except by approval of the Engineer. Single point tests may be used for quality assurance testing purposes.
6 Longitudinal profiles include vent hole and molded lines.
7 OIT and MI tests on the crown are required when resin used in the corrugation is different than that of the liner.
8 The incubation temperature and duration can also be 136 days at 185°F.
9 Within each replicate set of tests, the discrepancy range shall be within 6%. If an out-of range discrepancy occurs, repeat the three OIT tests.
10 The tests for incubated and “as-manufactured” pipe samples shall be performed by the same lab, same operator, the same testing device, and in the same day.
11 Within each replicate set of tests, the discrepancy range shall be within 9%. If an out-of-range discrepancy occurs, repeat the two MI tests on the same pipe sample. If insufficient material is available, a repeat of one test is acceptable.
12 The MI retained value is determined using the average MI value of incubated sample divided by the average MI value of as-manufactured pipe sample.

948-2.3.3 Certification: Furnish to the Engineer certification from the manufacturer for each pipe diameter manufacturers LOT to be incorporated into the project that the pipe meets the requirements of these Specifications.

Manufacturers seeking evaluation of a product in accordance with Departmental procedures must submit test reports conducted by a laboratory deemed to be appropriately qualified by the Plastics Pipe Institute and acceptable to the State Materials Engineer. Submit this information to the Director, State Materials Office.

948-2.3.4 Verification Samples: Furnish verification samples as directed by the Engineer.

948-3 Filter Fabric Sock for Use with Underdrain.

For Type I Underdrain specified in the Design Standards, Index No. 286, filter sock shall be an approved strong rough porous, polyester or other approved knitted fabric which completely covers and is secured to the perforated plastic tubing underdrain in such a way as to prevent infiltration of trench backfill material.

The knitted fabric sock shall be a continuous one piece material that fits over the tubing like a sleeve. It shall be knitted of continuous 150 denier yarn and shall be free from any chemical treatment or coating that might significantly reduce porosity and permeability.

The knitted fabric sock shall comply with the following physical properties:

Weight, applied (oz./sq. yd.)	3.5 min	ASTM D-3887
Grab tensile strength (lbs.)	50 min.*	ASTM D-5034
Equivalent opening size (EOS No.)	25 min.**	Corps of Engineers CW-02215-77
Burst strength (psi)	100 min.**	ASTM D-3887

*Tested wet.

**Manufacturer's certification to meet test requirement.

The knitted fabric sock shall be applied to the tubing in the shop so as to maintain a uniform applied weight. The tubing with knitted fabric sock shall be delivered to the job site in such manner as to facilitate handling and incorporation into the work without damage. The knitted fabric sock shall be stored in UV-resistant bags until just prior to installation. Torn or punctured knitted fabric sock shall not be used.

948-4 Pipe Liner.

948-4.1 Cured-In-Place Pipe Liner: Cured-in-place pipe liner shall be continuous, resin impregnated, flexible tubing that meets the requirements of ASTM D-5813 and ASTM F-1216.

948-4.2 Deformed Pipe Liner: Deformed pipe liner shall be manufactured in an out of round state, usually collapsed circumferentially and folded on the long axis. After installation in a host pipe, the liner is rounded by means of heat and pressure to fit the host pipe. Deformed pipe liner, when installed, shall extend from one structure to the next in one continuous length with no intermediate joints.

(1) Polyethylene: Deformed polyethylene pipe liner shall meet the requirements of ASTM D-3350 or ASTM F-714 with a minimum cell classification of 335420c.

(2) Polyvinyl Chloride: Deformed polyvinyl chloride pipe liner shall meet the requirements of ASTM F-1504 and shall have a minimum cell classification of 12456b.

948-4.3 Discrete Pipe Liner: Discrete pipe liner shall be round, flexible or semi-rigid liner, manufactured in lengths that may be joined in a manhole or access pit before insertion in a host pipe.

(1) Polyethylene: Discrete polyethylene pipe liner shall meet the requirements of ASTM D-3550 or ASTM F-714 and shall have a minimum of cell classification of 335420c.

(2) High Density Polyethylene Profile Wall: Discrete high density polyethylene pipe liner shall meet the requirements of ASTM F-894 and shall have a minimum cell classification of 335420c.

(3) Polyvinyl Chloride: Discrete polyvinyl chloride pipe liner shall meet the requirements of ASTM F-789, ASTM F-794, or ASTM F-949 and shall have a minimum cell classification of 12456b.

(4) Fiberglass: Discrete fiberglass pipe liner shall meet the requirements of ASTM D-3262.

948-4.4 Spiral Wound Pipe Liner: Spiral wound pipe liner shall consist of coils of profile strips that are wound into a host pipe helically, after which a cementitious grout is injected into the annular space between the liner and the host pipe, forming a rigid composite structure.

(1) Polyvinyl Chloride: Polyvinyl chloride spiral wound pipe liner shall meet the requirements of ASTM F-1697 or ASTM F-1698 and shall have a minimum cell classification of 12454b.

948-4.4.1 Machine Spiral Wound Pipe Liner: Machine spiral wound pipe liner shall consist of a continuous one piece profile strip wound directly into the deteriorated pipelines. The liner can be installed in close fit to the host pipe, or alternatively installed at a fixed diameter. Where the liner is installed at a fixed diameter, the annular space between the spiral wound liner pipe and the existing pipe is grouted.

(1) Polyvinyl Chloride: Polyvinyl chloride machine spiral wound pipe liner shall meet the requirements of ASTM F-1697 and shall have a minimum cell classification of 13354.

948-4.5 Paneled Pipe Liner: Paneled pipe liner consists of custom-cut flat or curved panels that are formed to the inside circumference of a host pipe.

(1) Polyvinyl Chloride: Polyvinyl chloride paneled pipe liner shall meet the requirements of ASTM F-1698 and shall have a minimum cell classification of 12454b.

948-4.6 Point Pipe Liner: Point pipe liner may consist of any materials covered by this specification when used to repair and rehabilitate an isolated portion of an existing storm drain pipe. Materials which are restricted (as primary components) to point repair are; steel, which shall meet the requirements of AASHTO M-167M, ASTM A-167, or ASTM A-240; aluminum, which shall meet the requirements of AASHTO M-196, and rubber; which shall meet the requirements of ASTM C-923.

948-4.7 Coated Pipe Liner: Coated pipe liner consists of liquid, slurry, foam or gel that is spread or sprayed over the interior surface of an existing pipe to rehabilitate it. Materials that may be used for coating are hydrophilic urethane gel, epoxy resin, polyester resin, gunite, shotcrete, low density cellular concrete, and cementitious grout.