



## Florida Department of Transportation

**RICK SCOTT**  
GOVERNOR

605 Suwannee Street  
Tallahassee, FL 32399-0450

**ANANTH PRASAD, P.E.**  
SECRETARY

January 18, 2011

Monica Gourdine  
Program Operations Engineer  
Federal Highway Administration  
545 John Knox Road, Suite 200  
Tallahassee, Florida 32303

Re: Office of Design, Specifications  
Section **948**  
Proposed Specification: **9480000 Miscellaneous Types of Pipe.**

Dear Ms. Gourdine:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

These changes were proposed by Mario Paredes of the State Materials Office to modify existing requirements for bridge drain pipe, add new types of pipe and for formatting.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via Email to SP965RP or rudy.powell@dot.state.fl.us.

If you have any questions relating to this specification change, please call Rudy Powell, State Specifications Engineer at 414-4280.

Sincerely,

Signature on file

Rudy Powell, Jr., P.E.  
State Specifications Engineer

RP/dt

Attachment

cc: Calvin Johnson, Chief Civil Litigation  
Florida Transportation Builders' Assoc.  
State Construction Engineer

**MISCELLANEOUS TYPES OF PIPE.**(REV ~~10-2711121-4182927810-1112~~)

SECTION 948 (Pages 900 - 906) is deleted and the following substituted:

**SECTION 948  
MISCELLANEOUS TYPES OF PIPE****948-1 Polyvinyl-Chloride (PVC) Pipe, or Acrylonitrile-Butadiene-Styrene (ABS) Plastics Pipe.**

**948-1.1 For Bridge Drains:** ~~PVC 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 ~~40-80~~ PVC pipe *with a minimum polymer cell classification of 12454 per ASTM D 1784 and a minimum of 1.5% by weight of titanium dioxide for UV- protection.* ~~For the portion of bridge drains not encased in concrete that are exposed to direct sunlight for any duration in a 24 hour period, the pipe may should be as specified in 948-1. A shielded from exposure. Where specified in the Plans, provide a water based, 100% acrylic paint coating. Unless otherwise stated in the Plans, use Federal Color Standard No. 595c, Color No. 36622.~~

**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~~ PVC 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:** ~~PVC polyvinyl chloride~~ pipe and ~~ABS 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:** ~~PVC 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:** ~~PVC 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. ~~PVC 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):** ~~PVC~~ 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. *Resin shall contain a minimum of 1.5% by weight of titanium dioxide for UV- protection.* 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.

All pipe produced and shipped to the job site shall meet the requirements of 105-3.2.

## 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 ~~E~~ 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 High Density Polyethylene Pipe (12 to 60- inches):

**948-2.3.1 General:** Class- I (50- year) 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.

All pipe produced and shipped to the job site shall meet the requirements of 105-3.2.

**948-2.3.2 Additional Requirements for Class- II (100- Year), Type- S Polyethylene Pipe** Meet the following requirements:

Table- 1			
Stress Crack Resistance of Pipes			
Pipe Location	Test Method	Test Conditions	Requirement

Table- 1			
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 $\geq 18.0$ hours, no single value shall be less than 13.0 hours.
Pipe Corrugation <sup>(1)</sup> , (molded plaque)	ASTM F-2136	10% Igepal solution at 122°F and 600- psi applied stress, 5 replicates	Average failure time shall be $\geq 24.0$ - hours, no single value shall be less than 17.0 hours.
Junction	FM 5-572, Procedure B and FM 5-573	Full Test <sup>(2)/(3)</sup> : Test at 3- temperature/stress combinations: 176°F at 650- psi 176°F at 450- psi 158°F at 650- psi; 5- replicates at each test condition	Determine failure time at 500- psi at 73.4°F $\geq 100$ years (95% lower confidence) using 15- failure time values <sup>(4)</sup> : The tests for each condition can be terminated at duration equal to or greater than the following criteria: 110.0- hr at 176°F 650 psi 430.0- hr at 176°F 450- psi 500.0- hr at 158°F 650- psi
		Single Test <sup>(5)</sup> : Test temperature 176°F and applied stress of 650- psi.; 5 replicates	The average failure time must be equal to or greater than 110.0- hr
Longitudinal Profiles <sup>(6)</sup>	FM 5-572, Procedure C, and FM 5-573	Full Test <sup>(2)/(3)</sup> : Test at 3- temperature/stress combinations: 176°F at 650- psi 176°F at 450- psi 158°F at 650- psi; 5- replicates at each test condition	Determine failure time at 500-psi at 73.4°F $\geq 100$ years (95% lower confidence) using 15- failure time values <sup>(4)</sup> . The tests for each condition can be terminated at duration equal to or greater than the following criteria: 110.0- hr at 176°F 650 psi 430.0- hr at 176°F 450- psi 500.0- hr at 158°F 650- psi
		Single Test <sup>(5)</sup> : Test temperature 176°F and applied stress of 650- psi.; 5 replicates	The average failure time must be equal to or greater than 110.0- hr
Oxidation Resistance of Pipes			
Pipe Location	Test Method	Test Conditions	Requirement

Liner and/or Crown <sup>(7)</sup>	OIT Test (ASTM D-3895)	2- replicates (to determine initial OIT value) on the as manufactured (not incubated) pipe.	25.0- minutes, minimum
Liner and/or Crown <sup>(7)</sup>	Incubation test FM 5-574 and OIT test (ASTM D-3895)	Three samples for incubation of <del>195-265</del> days at 176°F <sup>(8)</sup> and applied stress of 250 psi. One OIT test per each sample	Average of 3.0- minutes <sup>(9)</sup> ; <del>+09)</del> (no values shall be less than 2.0- minutes)
Liner and/or Crown <sup>(7)</sup>	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 <sup>(7)</sup>	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 <del>195-265</del> days at 176°F <sup>(8)</sup> and applied stress of 250- psi	MI Retained Value <sup>(109),(11)</sup> ; <del>(120)</del> 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 holes 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 ~~136-196~~ 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.~~

~~(109)~~ 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.~~

(120) 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.

Manufacturer may use ground eClass -II, but not eClass- I, pipe for reworked plastic.

**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 qualified by the Geosynthetic Accreditation Institute-Laboratory Accreditation Program (GAI-LAP) or qualified by ISO 17025 accreditation agency using personnel with actual experience running the test methods for eClass- II- HDPE pipe. Submit the test reports to the State Materials Office.

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

**948-3 Fiberglass Reinforced Polymer Pipe.**

**948-3.1 For Bridge Drains:** Fiberglass pipe shall conform to the requirements of ASTM D-2996 or ASTM D-2310, for Type I, Grade 2, Class E, ~~pipe~~ using polyvinyl ester as the only resin. The minimum designation ~~should~~ shall be RTRP-11EA. The resin ~~should~~ shall contain UV- ~~inhibitors and absorbers~~ stabilizers and/or a two-part ~~premium grade 100% solids~~ polyurethane coating. ~~For the portion of bridge drains not encased in concrete that are exposed to direct sunlight for any duration in a 24-hour period, the pipe should be shielded from exposure. Where specified in the Plans, provide a two-part 100% solids polyurethane coating. Unless otherwise stated in the Plans, use Federal Color Standard No. 595c, Color No. 36622.~~

**948-4 Ductile Iron Pipe.**

**948-4.1 For Bridge Drains:** Ductile iron pipe shall conform to the requirements of AWWA C151.

**948-5 Hot Dip Galvanized Steel Pipe.**

**948-5.1 For Bridge Drains:** Hot dip ~~G~~galvanized steel pipe shall conform to the requirements of ASTM A-53.

**948-6 Flexible Transition Couplings and Pipe.**

**948-6.1 For Bridge Drains:** Flexible transition couplers and pipe shall conform to the requirements of ASTM C-1173. ~~Where specified in the Plans, provide a water-based latex or acrylic paint coating appropriate for the elastomer used in the coupler. Unless otherwise stated in the Plans, use Federal Color Standard No. 595c, Color No. 36622.~~

**948-67 Profile Wall Polypropylene (PP) Pipe.**

PP pipe (12 to 60 inches) for side drain, cross drain, storm drain, and other specified applications shall meet the requirements of AASHTO MP21-11. Mitered end sections are not to be constructed of polypropylene. Use only concrete or metal mitered end sections as indicated in the Design Standards.

All pipe produced and shipped to the job site shall meet the requirements of 105-3.2. ~~For initial product approval,~~ ~~†~~The manufacturer shall demonstrate ~~adequate~~ that resin oxidation resistance ~~for the application~~ will last ~~50 years~~ using accelerated aging by use of incubation tests in accordance with FM 5-574. Tests shall demonstrate that stabilization package is present and that no degradation has occurred.

**948-378 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.

#### **948-489 Pipe Liner.**

**948-489.1 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.

**948-489.2 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 F-714 with a minimum cell classification of 335420c.

(2) ~~PVColyvinyl-Chloride~~: Deformed ~~pPVColyvinyl-chloride~~ pipe liner shall meet the requirements of ASTM F-1504.

**948-489.3 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) High Density Polyethylene Solid Wall: Discrete high density polyethylene pipe liner shall meet the requirements of ASTM F-714 or AASHTO- M-326 and shall have a minimum of cell classification of 345464c.

(2) High Density Polyethylene Profile Wall: Discrete high density polyethylene pipe liner shall meet the requirements of AASHTO- M-294 and shall have a minimum cell classification of 435400c.

(3) ~~PVColyvinyl-Chloride~~: Discrete ~~pPVColyvinyl-chloride~~ pipe liner shall meet the requirements of ASTM F-794, ASTM F-949, or AASHTO- M-304 and shall have a minimum cell classification of 12454.

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

**948-489.4 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) ~~PVColyvinyl-Chloride~~: ~~PVColyvinyl-chloride~~ spiral wound pipe liner shall meet the requirements of ASTM F-1697 or ASTM F-1735 and shall have a minimum cell classification of 12454.

**948-489.4.1 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) ~~PVColyvinyl-Chloride~~: ~~PVColyvinyl-chloride~~ machine spiral wound pipe liner shall meet the requirements of ASTM F-1697 and shall have a minimum cell classification of 12454.

**948-489.5 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) ~~PVColyvinyl-Chloride~~: ~~PVColyvinyl-chloride~~ paneled pipe liner shall meet the requirements of ASTM F-1735 and shall have a minimum cell classification of 12454.

**948-489.6 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.

**948-489.7 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.

**MISCELLANEOUS TYPES OF PIPE.****(REV 1-10-12)**

SECTION 948 (Pages 900 - 906) is deleted and the following substituted:

**SECTION 948**  
**MISCELLANEOUS TYPES OF PIPE**

**948-1 Polyvinyl-Chloride (PVC) Pipe, or Acrylonitrile-Butadiene-Styrene (ABS) Plastics Pipe.**

**948-1.1 For Bridge Drains:** PVC pipe shall conform to the requirements of ASTM D-1785, for Type I, Grade 1, Schedule 80 PVC pipe with a minimum polymer cell classification of 12454 per ASTM D 1784 and a minimum of 1.5% by weight of titanium dioxide for UV protection.

**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 PVC 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:** PVC pipe and ABS 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:** PVC 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:** PVC 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. PVC 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 PVC Pipe (12 to 36 Inches):** 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. Resin shall contain a minimum of 1.5% by weight of titanium dioxide for UV protection. 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.

All pipe produced and shipped to the job site shall meet the requirements of 105-3.2.

## **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 High Density Polyethylene Pipe (12 to 60 inches):**

**948-2.3.1 General:** Class I (50 year) 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.

All pipe produced and shipped to the job site shall meet the requirements of 105-3.2.

**948-2.3.2 Additional Requirements for Class II (100 Year), Type S Polyethylene Pipe** Meet the following requirements:

Table 1			
Stress Crack Resistance of Pipes			
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 ≥18.0 hours, no single value shall be less than 13.0 hours.

Table 1			
Pipe Corrugation <sup>(1)</sup> , (molded plaque)	ASTM F-2136	10% Igepal solution at 122°F and 600 psi applied stress, 5 replicates	Average failure time shall be $\geq 24.0$ hours, no single value shall be less than 17.0 hours.
Junction	FM 5-572, Procedure B and FM 5-573	Full Test <sup>(2)(3)</sup> Test at 3 temperature/stress combinations: 176°F at 650 psi 176°F at 450 psi 158°F at 650 psi; 5 replicates at each test condition	Determine failure time at 500 psi at 73.4°F $\geq$ 100 years (95% lower confidence) using 15 failure time values <sup>(4)</sup> The tests for each condition can be terminated at duration equal to or greater than the following criteria: 110.0 hr at 176°F 650 psi 430.0 hr at 176°F 450 psi 500.0 hr at 158°F 650 psi
		Single Test <sup>(5)</sup> : Test temperature 176°F and applied stress of 650 psi.; 5 replicates	The average failure time must be equal to or greater than 110.0 hr
Longitudinal Profiles <sup>(6)</sup>	FM 5-572, Procedure C, and FM 5-573	Full Test <sup>(2)(3)</sup> : Test at 3 temperature/stress combinations: 176°F at 650 psi 176°F at 450 psi 158°F at 650 psi; 5 replicates at each test condition	Determine failure time at 500psi at 73.4°F $\geq$ 100 years (95% lower confidence) using 15 failure time values <sup>(4)</sup> . The tests for each condition can be terminated at duration equal to or greater than the following criteria: 110.0 hr at 176°F 650 psi 430.0 hr at 176°F 450 psi 500.0 hr at 158°F 650 psi
		Single Test <sup>(5)</sup> : Test temperature 176°F and applied stress of 650 psi.; 5 replicates	The average failure time must be equal to or greater than 110.0 hr
Oxidation Resistance of Pipes			
Pipe Location	Test Method	Test Conditions	Requirement
Liner and/or Crown <sup>(7)</sup>	OIT Test (ASTM D-3895)	2 replicates (to determine initial OIT value) on the as manufactured (not incubated) pipe.	25.0 minutes, minimum

Liner and/or Crown <sup>(7)</sup>	Incubation test FM 5-574 and OIT test (ASTM D-3895)	Three samples for incubation of 265 days at 176°F <sup>(8)</sup> and applied stress of 250 psi. One OIT test per each sample	Average of 3.0 minutes <sup>(9)</sup> (no values shall be less than 2.0 minutes)
Liner and/or Crown <sup>(7)</sup>	MI test (ASTM D-1238 at 190°C/2.16Kg)	2 replicates on the as manufactured (not incubated) pipe.	< 0.4 g/10 minutes
Liner and/or Crown <sup>(7)</sup>	Incubation test FM 5-574 and MI test (ASTM D-1238 at 190°C/2.16Kg)	2 replicates on the three aged sampled after incubation of 265 days at 176°F <sup>(8)</sup> and applied stress of 250 psi	MI Retained Value <sup>(9)(10)</sup> 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 holes 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 196 days at 185°F.

(9) 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.

(10) 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.

Manufacturer may use ground Class II, but not Class I, pipe for reworked plastic.

**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 qualified by the Geosynthetic Accreditation Institute-Laboratory Accreditation Program (GAI-LAP) or qualified by ISO 17025 accreditation agency using personnel with actual experience running the test methods for Class II HDPE pipe. Submit the test reports to the State Materials Office.

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

### 948-3 Fiberglass Reinforced Polymer Pipe.

**948-3.1 For Bridge Drains:** Fiberglass pipe shall conform to the requirements of ASTM D-2996 or ASTM D-2310, for Type I, Grade 2, Class E, using polyvinyl ester as the only resin. The minimum designation shall be RTRP-11EA. The resin shall contain UV stabilizers or a two-part 100% solids polyurethane coating.

**948-4 Ductile Iron Pipe.**

**948-4.1 For Bridge Drains:** Ductile iron pipe shall conform to the requirements of AWWA C151.

**948-5 Hot Dip Galvanized Steel Pipe.**

**948-5.1 For Bridge Drains:** Hot dip galvanized steel pipe shall conform to the requirements of ASTM A-53.

**948-6 Flexible Transition Couplings and Pipe.**

**948-6.1 For Bridge Drains:** Flexible transition couplers and pipe shall conform to the requirements of ASTM C-1173.

**948-7 Profile Wall Polypropylene (PP) Pipe.**

PP pipe (12 to 60 inches) for side drain, cross drain, storm drain, and other specified applications shall meet the requirements of AASHTO MP21-11. Mitered end sections are not to be constructed of polypropylene. Use only concrete or metal mitered end sections as indicated in the Design Standards.

All pipe produced and shipped to the job site shall meet the requirements of 105-3.2. The manufacturer shall demonstrate that resin oxidation resistance will last using accelerated aging by use of incubation tests in accordance with FM 5-574. Tests shall demonstrate that stabilization package is present and that no degradation has occurred.

**948-8 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.

**948-9 Pipe Liner.**

**948-9.1 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.

**948-9.2 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 F-714 with a minimum cell classification of 335420c.

(2) PVC: Deformed PVC pipe liner shall meet the requirements of ASTM F-1504.

**948-9.3 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) High Density Polyethylene Solid Wall: Discrete high density polyethylene pipe liner shall meet the requirements of ASTM F-714 or AASHTO M-326 and shall have a minimum of cell classification of 345464c.

(2) High Density Polyethylene Profile Wall: Discrete high density polyethylene pipe liner shall meet the requirements of AASHTO M-294 and shall have a minimum cell classification of 435400c.

(3) PVC: Discrete PVC pipe liner shall meet the requirements of ASTM F-794, ASTM F-949, or AASHTO M-304 and shall have a minimum cell classification of 12454.

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

**948-9.4 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) PVC: PVC spiral wound pipe liner shall meet the requirements of ASTM F-1697 or ASTM F-1735 and shall have a minimum cell classification of 12454.

**948-9.4.1 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) PVC: PVC machine spiral wound pipe liner shall meet the requirements of ASTM F-1697 and shall have a minimum cell classification of 12454.

**948-9.5 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) PVC: PVC paneled pipe liner shall meet the requirements of ASTM F-1735 and shall have a minimum cell classification of 12454.

**948-9.6 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.

**948-9.7 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.