

DRAINAGE MATERIALS

SECTION 941 CONCRETE PIPE (FOR CULVERT AND UNDERDRAINS)

941-1 Concrete Culvert Pipe (Round).

941-1.1 General Specifications: Round concrete culvert pipe shall meet the requirements of ASTM C 76 [ASTM C 76M], except as modified herein, and shall conform to the specific requirements of this Section.

941-1.2 Specific Requirements:

Concrete Pipe shall meet the design requirements of the class of pipe called for in the plans. Pipe design shall be based upon requirements set forth in ASTM C 76 [ASTM C 76M] or Special Designs which meet the requirements of ASTM C 655 [ASTM C 655M]. For pipe designated as Class S, the pipe design will meet the requirements for ASTM C 655 [ASTM C 655M] and the 0.01 inch [0.3 mm] crack and ultimate D-loads given on the Design Standards, Index Number 205.

The process of manufacture and the details of the pipe design, including strength of the concrete, will comply with the Standard Operating Procedure for the Inspection of Precast Drainage Products.

At the Contractor's option, non-reinforced pipe up to and including 36 inches [900 mm] in diameter, may be used in place of reinforced concrete pipe designated Class S, Class I, Class II, Class III, and Class IV. Non-reinforced pipe shall meet the requirements of ASTM C 985 and the ultimate D-loads given on the Design Standards, Index Number 205. Such pipe shall be properly marked.

941-1.3 Modifications to ASTM C 76 [ASTM C 76M]: The following shall supersede the provisions of ASTM C 76 [ASTM C 76M]:

(a) The materials used in concrete must be certified from the source and shall conform to the following:

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|------------------------------------|--------------|
| (1) Portland Cement..... | Section 921 |
| (2) Fine Aggregate..... | Section 902 |
| (3) Coarse Aggregate..... | Section 901 |
| (4) Water..... | Section 923 |
| (5) Admixtures..... | ASTM C 494 |
| (6) Fly Ash..... | Section 929 |
| (7) Blended Hydraulic Cements..... | AASHTO M 240 |

The gradation requirements for concrete aggregates as set forth in Sections 901 and 902 shall not apply.

(b) All Joint Reinforcement shall be according to the Department's Design Standards.

(c) When membrane curing compounds are used, they shall meet the requirements of 925-2. The compounds shall be applied according to 400-16. The curing compound shall be applied immediately after the pipe has been removed from the form.

(d) Each manufacturer of the pipe shall provide a suitable apparatus for testing his product in accordance with FM 3-C 497. Upon the request of the Engineer and under his supervision, the manufacturer shall perform tests outlined in FM 3-C 497 as the Engineer may deem necessary in order to establish the quality of the product as required by these specifications. No payment or allowance will be made to the manufacturer for such equipment, for expenses in testing, or for the pipe broken.

(e) Variation of laying lengths of two opposite sides of pipe shall not be more than 1.04% of the diameter, with a maximum of 1/2 inch [13 mm] in any length of pipe, except where beveled-end pipe for laying on curves is specified.

(f) All marking on precast pipe shall include the type of wall.

(g) All repairs shall be in accordance with 941-1.5.3.

941-1.4 Specific Causes for Rejection of Pipe: Specific causes for rejection of concrete pipe, in addition to any failure to meet the general requirements specified above, are as follows:

(a) Failure to meet the requirements listed in ASTM C 76 [ASTM C 76M] for permissible variations in dimensions with the exceptions outlined in 941-1.3 above.

(b) Occurrence of defects listed in ASTM C 76 [ASTM C 76M].

941-1.5 Special Requirements for Pipe Joints when Round Rubber Gaskets are to be used:

941-1.5.1 General: When round rubber gaskets are to be installed in the pipe joint, the gasket shall be the sole element relied on to maintain a tight joint. These Specifications shall be used in conjunction with the Design Standards outlining other requirements for this type of construction.

941-1.5.2 Design of Joint: The joint shall be of the bell-and-spigot type or the double spigot and sleeve type, meeting the requirements called for on the Design Standards, which includes such details. The joint shall be so proportioned that the spigot, or spigots, shall readily enter the bell or sleeve of the pipe.

The joint ring forms for forming the joint surface shall be of heavy steel, cast iron, or aluminum, and shall be accurately machined to the dimensions of the joint. They shall be a true circular form within a tolerance of 1/32 inch [1 mm]. Dimensional checks of joint ring form shall indicate for each size pipe a length of spigot, or tongue, not more than 1/8 inch [3 mm] shorter than the bell, or groove, depth. The pipe shall be so manufactured that joint surfaces are concentric with the inside of the pipe within a tolerance of 3/32 inch [2.5 mm]. The shape and dimensions of the joint shall be such as to provide compliance with the following requirements:

(a) The joint shall be so dimensioned that when the gasket to be used is placed on the spigot it will not be stretched more than 20% of its original length.

(b) The space provided for the gasket shall be a groove in the spigot end of the pipe and such space, when the joint is made, shall not be more than 110% of the volume of the gasket.

(c) The joint shall be designed so that when the outer surface of the spigot and the inner surface of the bell come into contact at some point on the periphery, the diametric deformation in the gasket at the point of contact shall not be greater than 50% of the normal gasket diameter, and the diametric deformation in the gasket at a point opposite the contact point shall not be less than 20% of the normal gasket diameter.

(d) When the pipes are joined, there shall be parallel surfaces on both the bell and the spigot, extending from the edge of the gasket toward the bell face for a distance of not less than 3/4 inch [19 mm]. These parallel surfaces shall in no case be farther apart than 1/8 inch [3 mm] when the spigot is centered in the bell. The tapers on these surfaces shall not exceed three degrees.

(e) The inside surface of the bell at the end of the bell shall be flared to facilitate joining the pipe sections without damaging or displacing the gasket.

941-1.5.3 Tolerances in Imperfections, and Permissible Repairs: The entire surfaces of near-contact of the jointed pipes shall be free from air holes, chipped or spalled concrete, laitance, and other such defects.

Pipes showing minor manufacturing imperfections or handling injuries to the bell or spigot may be acceptable if such defects can be, and are, acceptably repaired as prescribed below.

Individual air holes (trapped air), or spalled areas with a length of up to one-half the pipe radius, or 12 inches [300 mm] whichever is less, may be repaired by careful use of a hand-placed, stiff, pre-shrunk, 1-to-1 mortar of cement and fine sand, and with no additional preparation other than a thorough washing with water of the defect. Curing shall be done either by moisture curing under wet burlap or by application of an approved membrane curing compound. Such repaired pipe which is sound, properly finished and cured, and which otherwise conforms to specification requirements will be acceptable.

Exposed reinforcing and minor spalling in the spigot groove may be accepted if repaired in the following manner: The spalled areas will be chipped back to solid concrete. Exposed reinforcing will be cleaned of all laitance and scale. The entire area is to be coated with an approved epoxy at a thickness of 5 to 10 mils [125 to 250 μm]. The coating shall be smooth and conform to the shape of the groove. The epoxy shall be a Type F-1 as specified in Section 926.

941-1.6 Special Requirements for Pipe Joints when Profile Rubber Gaskets are used: When profile rubber gaskets are to be installed in the pipe joints, the gaskets shall be considered to be the sole element relied on to maintain a tight joint. The joint design shall meet the requirements set forth in Article 7 of ASTM C 443.

941-2 Elliptical Concrete Pipe.

Elliptical concrete pipe shall conform with the requirements of ASTM C 507 [ASTM C 507M], except that the exceptions and modifications to ASTM C 76 [ASTM C 76M], as specified in 941-1.3 for round concrete pipe, shall apply also to elliptical pipe, where applicable. Standard elliptical pipe shall meet the requirements of Table I for Class HE-III and special elliptical pipe shall meet the requirements of Table I for Class HE-IV.

When profile rubber gaskets are to be installed in the pipe joints, the gaskets shall be considered to be the sole element relied on to maintain a tight joint. However, a filter fabric jacket shall also be used as specified in 430-7.3. The joint design shall meet the requirements set forth in Article 7 of ASTM C 443 [ASTM C 443M].

941-3 Concrete Underdrain Pipe.

Concrete pipe for underdrains shall be perforated, and shall meet the requirements of ASTM C 444 [ASTM C 444M], with the following modifications:

(a) Strength of Finished Pipe: Underdrain pipe will not be required to be reinforced, and will not be tested for strength of the finished pipe. Approval of the strength of the finished pipe will be based on visual inspection and check.

(b) Perforations: The perforations shall be molded into the pipe at the time of fabrication, and any undue chips, fractures, etc., incurred thereby, either in the interior of the pipe or on the periphery, which are sufficient to significantly impair the strength or efficiency, will be cause for rejection of the pipe.

The perforations shall be circular, and of the diameter called for below, with a tolerance of ±1/16 inch [±2 mm]. In all pipe included in any single order, or for any single installation operation, such diameter shall be reasonably uniform.

SCHEDULE OF PERFORATIONS FOR CONCRETE UNDERDRAIN PIPE				
Internal Diameter of Pipe	Diameter of Perforations *(Design)	No. of Rows	**Approximate Rows between Rows	**Spacing within Rows
6 inches [150 mm]	3/8 inch [10 mm]	4	4 inches [100 mm]	5-6 inches [125-150 mm]
6 inches [150 mm]	1/4 inch [6 mm]	4	4 inches [100 mm]	4-5 inches [100-125 mm]
8 inches [200 mm]	3/8 inch [10 mm]	4	5 inches [125 mm]	5-6 inches [125-150 mm]
8 inches [200 mm]	1/4 inch [6 mm]	4	5 inches [125 mm]	4-5 inches [100-125 mm]

*1/16 inch [2 mm] fabrication tolerance, over and under.

**Perforations to be staggered in alternate rows. The spacing between rows shall be uniform.