

**SECTION 449**  
**PRECAST CONCRETE DRAINAGE PRODUCTS**

**449-1 Description.**

Obtain precast drainage products from a qualified precast concrete drainage products plant. Precast concrete drainage products hereinafter called products, may include but is not limited to, round concrete pipe, elliptical concrete pipe, underdrains, manholes, endwalls, inlets, junction boxes, three-sided precast concrete culverts, and precast concrete box culverts.

Ensure that all precast drainage products are designed and manufactured in accordance with the requirements of the Contract Documents.

A precast concrete drainage products plant, hereinafter called plant, is an independent operating facility capable of all operations necessary to fabricate, store, and transport products. Each qualified product plant is required to have an approved Quality Control Plan (QCP) meeting the requirements of 6-8.

Obtain precast concrete pipes from a plant that is currently on the Department's list of qualified precast concrete pipe plants and meet the requirements of Section 6.2 of Materials Manual.

Obtain precast drainage structures from a plant that is currently on the Department's list of qualified precast drainage structures plants and meet the requirements of Section 6.3 of the Materials Manual which is available at the following URL:

<http://www11.myflorida.com/specificationsoffice/materialsmanual/section63.pdf> .

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 approved QCP and Contract Documents.

Accept responsibility of either obtaining products from another approved plant, or await re-approval of the plant, when the plant is removed from the Department's list of qualified product plants.

The Engineer will not allow changes in Contract Time or completion dates as a result of the plant's loss of qualification. Accept responsibility for all delay costs or other costs associated with the loss of plant's qualification.

**449-2 Materials.**

Ensure that the materials used for the construction of the precast drainage products have a certification statement from the source, showing that they meet the applicable requirements of the Specifications with the following modifications:

|  |   |
|--|---|
| Portland Cement and blended cement ..... | Section 921                                       |
| Fine Aggregate* .....                    | Section 902                                       |
| Coarse Aggregate* .....                  | Section 901                                       |
| Water .....                              | Section 923                                       |
| Admixtures .....                         | Section 924                                       |
| Blended Hydraulic Cements .....          | AASHTO M 240                                      |
| Pozzolans and slag .....                 | Section 929                                       |
| Gasket Material .....                    | Section 942                                       |
| Welded Wire Fabric .....                 | ASTM A 185 or ASTM A 497                          |
| Reinforcing Bar .....                    | Section 415                                       |
| Wire for Site Cage Machines .....        | ASTM A 82, ASTM A 496 or ASTM A 615 [ASTM A 615M] |

\*For concrete pipes the gradation requirements of concrete aggregates as set forth in Sections 901 and 902 are not applicable.

### 449-3 Construction Requirements.

Unless otherwise stipulated within the Contract Documents, meet the following requirements for concrete mix, product design, fabrication, transportation, and installation:

|   |  |
|---|--|
| Steel Reinforced Round Concrete Pipe..... | ASTM C 76 [ASTM C 76M]                   |
| Reinforced Elliptical Concrete Pipe.....  | ASTM C 507 [ASTM C 507]                  |
| Inlets, Manholes, and Junction Boxes..... | Section 425 and ASTM C 478 [ASTM C 478M] |
| Three-Sided Precast Culverts.....         | Section 407                              |
| Pipe Culverts and Storm Sewers.....       | Section 430                              |
| Precast Concrete Box Culvert.....         | Section 410                              |
| Underdrains.....                          | Section 440 and ASTM C 444               |
| French Drains.....                        | Section 443                              |
| Non-reinforced Concrete Pipe .....        | ASTM C 985 [ASTM C 985M]                 |
| Fiber Reinforced Concrete Pipe.....       | ASTM C 1450                              |

Meet the special requirements for the applicable pipes as described in 449 -4 through 449-6.

### 449-4 Concrete Pipe.

**449-4.1 Special Requirements for Steel Reinforced Concrete Pipe:** Use pipe meeting the requirements of ASTM C 76 [ASTM C 76M] with the modifications as described in 449-4.2. Use Special Designed pipe meeting the requirements of ASTM C 655 [ASTM C 655M]. Use Class S pipe meeting the requirements of ASTM C 655 [ASTM C 655M] and the 0.01inch [0.03 mm] crack and ultimate D - loads given on the Design Standards, Index 205. Ensure all pipes are properly marked.

**449-4.2 Modifications to ASTM C 76 [ASTM C 76M] and ASTM C 507 [ASTM C 507M]:** The following supersedes the provisions of ASTM C 76 [ASTM C 76M] and ASTM C 507 [ASTM C 507M]:

(a) Ensure all materials used in concrete are certified from the source and conform to the requirements of 449-2.

(b) Ensure all Joint Reinforcement requirements are in accordance with the Design Standards.

(c) When membrane curing compounds are used, ensure that the requirements of 925-2 are met and the membrane curing compounds are applied in accordance with 400-16 immediately after the pipe has been removed from the form.

(d) Ensure the manufacturer has a suitable apparatus for testing each product in accordance with ASTM C 497 [ASTM C 497M] and performs all tests outlined in ASTM C 497 [ASTM C 497M] when requested by the Engineer.

(e) Ensure that the variation of laying lengths of two opposite sides of pipe is not 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) Ensure that the type of wall markings is included on all precast pipes.

(g) Ensure all repairs are made in accordance with Section 449-6.4.

**449-4.3 Special Requirements for Non-Reinforced Concrete Pipe:** Ensure the requirements of ASTM C 985 [ASTM C 985M] and the ultimate D - loads given on the Design Standards, Index 205 are met with the following exception: Modify material requirements set forth in ASTM C 985 [ASTM C 985M] with the material requirements set forth in 449-2. Ensure all pipes are properly marked.

**449-4.4 Special Requirements for Reinforced Elliptical Concrete Pipe:** Use elliptical concrete pipes conforming to the requirements of ASTM C 507 [ASTM C 507M], except for the exceptions and modifications as specified in 449-4.2. Ensure the requirements of Table I of ASTM C 507 [ASTM C 507M] for standard elliptical pipe, the requirements of Class HE-III and Class HE-IV of Table I of ASTM C 507 [ASTM C 507M] for Standard elliptical pipe and special elliptical pipe, respectively are met and the joint design requirements set forth in Article 7 of ASTM C 443 [ASTM C 443M] are met.

**449-4.5 Concrete Underdrain Pipe:** Use perforated concrete pipe for underdrains meeting 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 must be molded into the pipe at the time of fabrication, and any undue chips, fractures, 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.

Ensure the perforations are circular, and of the diameter called for below, with a tolerance of  $\pm 1/16$  inch [ $\pm 2$  mm]. Furnish all pipe included in any single order, or for any single installation operation, such diameter is reasonably uniform.

| Schedule of Perforations For Concrete Underdrain Pipe |                                    |             |                                     |                            |
|---|------------------------------------|-------------|-------------------------------------|----------------------------|
| Internal Diameter of Pipe                             | Diameter of Perforations *(Design) | No. of Rows | **Approximate distance between Rows | **Spacing within Rows      |
| 6 inches<br>[150 mm]                                  | 3/8 inch<br>[10 mm]                | 4           | 4 inches<br>[100 mm]                | 5-6 inches<br>[125-150 mm] |
| 6 inches<br>[150 mm]                                  | 1/4 inch<br>[6 mm]                 | 4           | 4 inches<br>[100 mm]                | 4-5 inches<br>[100-125 mm] |
| 8 inches<br>[200 mm]                                  | 3/8 inch<br>[10 mm]                | 4           | 5 inches<br>[125 mm]                | 5-6 inches<br>[125-150 mm] |
| 8 inches<br>[200 mm]                                  | 1/4 inch<br>[6 mm]                 | 4           | 5 inches<br>[125 mm]                | 4-5 inches<br>[100-125 mm] |

\*1/16 inch [2 mm] fabrication tolerance, over and under.  
 \*\*Perforations to be staggered in alternate rows. The spacing between rows must be uniform.

**449-4.6 Rejection of Concrete Pipe:** Specific causes for rejection of concrete pipe, in addition to any failure to meet the general requirements specified in the Contract Documents, are as follows:

(a) Failure to meet the requirements listed in ASTM C 76 [ASTM C 76M] for permissible variations in dimensions with the modifications outlined in 449-4.1 and 449-4.2.

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

**449-5 Fiber Reinforced Concrete Pipe.**

**449-5.1 Special Requirements for Fiber Reinforced Concrete Pipe:** Use fiber reinforced concrete pipe meeting the requirements of ASTM C 1450 as modified in herein. Use only pipes that are properly marked.

Use pipe meeting the applicable material requirements set forth in 449-2. In addition, fiber reinforced concrete pipe must be designated Class S, Class I, Class II, Class III or Class IV. The corresponding strength requirements are given in the following table:

| Minimum Long-Term Service D-Load |                   |
|----------------------------------|-------------------|
| Pipe Class                       | Lb/ft/ft [N/m/mm] |
| S                                | 600 [30]          |
| I                                | 800 [40]          |
| II                               | 1,000 [50]        |
| III                              | 1,350 [65]        |
| IV                               | 2,000 [100]       |

Ensure the relationship between short-term crush loads required to achieve 100-year long-term design loads and the relationship between the saturated and dry crush loads are provided. The

minimum dry crush load can not be less than a factor of 2 times the long-term service load. The short term crush load will be determined as required in Section 10.2 of ASTM C 1450 except the specimen will be tested by the appropriate section of ASTM C 497 [ASTM C 497], External Load Crushing Strength by the Three-Edge Bearing Test Method.

Expand Section 5.1 of ASTM C 1450 with the following: Provide documented evidence that the type of fiber, used in the manufacturing, is compatible with other materials of manufacture.

Expand Section 6 of ASTM C 1450 with the following: Provide the minimum wall dimensions of the pipe that complies with the minimum crush loads presented in the table above.

In lieu of Section 6.2 of ASTM C 1450 meet the following: The under run in length of a section of pipe can not be more than 1/8 in/ft [10 mm/m] with a maximum of 1/2 inch [12.7 mm] in any single pipe.

In lieu of Section 6.3 of ASTM C 1450 meet the following: The average inside diameter is required to be equal to or more than the nominal size by more than 0.25 inch [6 mm] or 1.5% of the nominal size, whichever is the greater value.

In lieu of Section 7.1 of ASTM C 1450 meet the following: All material tested under this Specification must be tested in the saturated condition after immersion in water at an ambient temperature above 41°F [5°C] for a period of 21 to 28 days immediately before testing.

In lieu of Section 8 of ASTM C 1450 meet the following: Each length of pipe must be provided with a joint for the purpose of maintaining alignment and to ensure a close joint. Design joints such that the ends of the pipe sections are laid together they will make a continuous line of pipe with a smooth interior free of appreciable irregularities and compatible with the tolerances in Section 6 of ASTM C 1450.

#### **449-6 Requirements For Pipe Joints When Rubber Gaskets Are To Be Used:**

**449-6.1 Design of Joint:** Use pipe of the joint of the bell-and-spigot type or the double spigot and sleeve type, meeting the requirements called for in the Design Standards. Ensure the joint is so proportioned that the spigot, or spigots, will readily enter the bell or sleeve of the pipe.

Ensure the joint ring forms for forming the joint surface are made of either heavy steel, cast iron, or aluminum, and accurately machined to the dimensions of the joint. They must be a true circular form within a tolerance of 1/32 inch [1 mm]. Dimensional checks of joint ring form will 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 will 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 must be such as to provide compliance with the following requirements:

(a) The joint must be so dimensioned that when the gasket is placed on the spigot it will not be stretched more than 20% of its original length, or the maximum stretch length that is recommended by the manufacturer, whichever is lower.

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

(c) The joint must 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 cannot be greater than 50% of the normal gasket diameter, and the diametric deformation in the gasket at a point opposite the contact point cannot be less than 20% of the normal gasket diameter.

(d) When the pipes are joined, there must be parallel surfaces on both the bell and the spigot, extending from the outside edge of the gasket toward the bell face for a distance of not less than 3/4 inch [19 mm]. These parallel surfaces cannot be farther apart than 1/8 inch [3 mm], when the spigot is centered in the bell. The tapers on these surfaces cannot exceed three degrees.

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

**449-6.2 When Rubber gaskets are Used:** The gasket is the sole element relied on to maintain a tight joint. Perform hydrostatic tests on pipe joints at the plant in accordance with ASTM C 443 [ASTM C 443M] test methods. Soil tight joints must be watertight to 2 psi [13.8 kPa]. Watertight joints must be watertight to 5 psi [34.5 kPa] unless a higher pressure rating is required in the plans.

**449-6.3 When Profile Rubber Gaskets are Used:** The gaskets will be the sole element relied on to maintain a tight joint. Ensure the joint design meets the requirements set forth in Article 7 of ASTM C 443 [ASTM C 443M].

**449-6.4 Tolerances in Imperfections, and Permissible Repairs for Joint of Concrete**

**Gasketed Pipe:** Ensure that all surfaces of near-contact of the jointed pipes are 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 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 will 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  $\mu\text{m}$ ]. The coating must be smooth and conform to the shape of the groove. The epoxy must be a Type F-1 as specified in Section 926.