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Standard Specification for Nonreinforced Concrete Irrigation Pipe With Rubber Gasket Joints (Metric)[1]

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1. Scope

1.1 This specification covers nonreinforced concrete pipe with rubber gasket joints to be used for the conveyance of irrigation water with working pressures, including hydraulic transients, as shown in Table 1.

1.2 This specification is the SI counterpart of Specification C505.

NOTE 1—This specification is for manufacturing and purchase only and does not include requirements for bedding, backfill, installation, or field repairs. The owner is cautioned that he must correlate field conditions with the characteristics of the pipe specified and provide inspection during installation.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C33 Specification for Concrete Aggregates
C150 Specification for Portland Cement
C497M Test Methods for Concrete Pipe, Manhole Sections, or Tile [Metric]
C595 Specification for Blended Hydraulic Cements
C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C822 Terminology Relating to Concrete Pipe and Related Products
C989 Specification for Slag Cement for Use in Concrete and Mortars
C1116 Specification for Fiber-Reinforced Concrete and Shotcrete
D395 Test Methods for Rubber PropertyCompression Set
D412 Test Methods for Vulcanized Rubber and Thermoplastic ElastomersTension
D471 Test Method for Rubber PropertyEffect of Liquids
D573 Test Method for RubberDeterioration in an Air Oven
D1149 Test Methods for Rubber DeteriorationCracking in an Ozone Controlled Environment
D1415 Test Method for Rubber PropertyInternational Hardness
D2240 Test Method for Rubber PropertyDurometer Hardness

3. Terminology

3.1 *Definitions*—For definitions of terms relating to concrete pipe, see Terminology C822.

4. Classification

4.1 Pipe manufactured in accordance with this specification shall be known as "Standard Nonreinforced Concrete Irrigation Pipe with Rubber Gasket Joints."

5. Basis of Acceptance

5.1 The acceptability of the pipe, joint design, and gaskets shall be determined by the results of the tests prescribed in this specification, if and when required, and by inspection to determine whether the pipe and gaskets conform to the specification as to design and freedom from defects.

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[1] This specification is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.01 on Non-Reinforced Concrete Sewer, ~~Drain,~~Drain and Irrigation Pipe.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

TABLE 1 Standard Dimensions, Working Pressures, and Test Requirements

Designated Internal Diameter, mm	Wall Thickness,[A] mm	Working Pressure,[B] m	Required Hydrostatic Test Pressure,[C] kPa	Minimum Three-Edge-Bearing Load, kN/linear metre
150	19	9	275	19.0
200	25	9	275	19.5
250	32	9	275	20.5
300	38	9	275	22.0
375	47	9	275	24.0
450	57	9	275	26.5
525	66	9	275	27.5
600	75	9	275	29.0

[A] Thinner walls are not prohibited on pipe units not over 1.22 m in length but the thickness of such walls should be not less than the internal diameter divided by 10.
[B] With the exception of 525 and 600-mm pipe, higher working pressures are not prohibited to be used up to a maximum of 15 m for 150 through 300-mm diameters and 12 m for 375 through 450-mm diameters. In these cases the strength of the pipe shall be increased to give minimum internal hydrostatic test pressures of at least three times the design working pressure when tested as specified in 10.4.
[C] For hydrostatic test requirements, refer to 10.4.

6. Materials and Manufacture

6.1 *Concrete*—The concrete shall consist of cementitious materials, mineral aggregates, and water.

6.2 *Cementitious Materials*:

6.2.1 *Cement*—Cement shall conform to the requirements for portland cement of Specification C150 or shall be portland blast-furnace slag cement, or slag-modified portland cement, or portland-pozzolan cement conforming to the requirements of Specification C595, except that the pozzolan constituent in the Type IP portland pozzolan cement shall be fly ash.

6.2.2 *Fly Ash*—Fly ash shall conform to the requirements of Class F or Class C of Specification C618.

6.2.3 *Ground Granulated Blast Furnace Slag (GGBFS)*—GGBFS shall conform to the requirements of Grade 100 or 120 of Specification C989.

6.2.4 *Allowable Combinations of Cementitious Materials*—The combination of cementitious materials used in the concrete shall be one of the following:

6.2.4.1 Portland cement only,

6.2.4.2 Portland blast furnace slag cement only,

6.2.4.3 Slag modified portland cement only,

6.2.4.4 Portland pozzolan cement only,

6.2.4.5 A combination of portland cement and fly ash,

6.2.4.6 A combination of portland cement and ground granulated blast-furnace slag, or

6.2.4.7 A combination of portland cement, fly ash (not to exceed 25 % of the total cementitious weight) and ground granulated blast furnace slag (not to exceed 25 % of the total cementitious weight).

6.3 *Aggregates*—Aggregates shall conform to Specification C33, except that the requirements for gradation shall not apply.

6.4 *Admixtures and Blends*—~~Admixtures and blends shall only be used with the approval of the owner.~~ —Owner is not prohibited from obtaining the record of mix design used.

6.5 *Gaskets*:

6.5.1 *Composition*—The rubber compound used in the manufacture of the gasket shall be compounded from natural rubber, synthetic rubber, or a mixture of the two fabricated as prescribed in 6.5.2 to 6.5.6, inclusive.

6.5.2 *Fabrication*—Gaskets shall be extruded or molded and cured in such a manner that they will be dense and homogeneous at any cross section, and have uniform dimensions. They shall be free from porosity, blisters, pitting, and other defects, which will affect their serviceability.

6.5.3 *Tolerances*—Commercial tolerances A3-F3, T.032 for molded gaskets, and A3-F3 for extruded gaskets in accordance with the *Rubber Handbook*[3] shall be permitted. The tolerances in gasket and joint dimensions shall be such as not to exceed permissible deformations prescribed in Section 8.

6.5.4 *Physical Properties of Gaskets*—The rubber from which the gaskets are fabricated shall have the following physical properties:

Ultimate elongation at break, min, %	350
Ultimate elongation at break after aging, min, % of elongation before aging	80
Hardness, International Rubber Hardness Degrees or Durometer[A]	40 to 60

[3] Available from the Rubber Manufacturers Assn., Inc., 1400 K St., NW, suite 900, Washington DC, 20005.

Compression set, max, %	25
Water absorption, %	10
Ozone resistance	no cracks in accordance with Method D1149

[A] Allowable variation ±5 from manufacturer's specified hardness.

6.5.4.1 Testing shall be in accordance with Section 9.

6.5.5 *Strength of Splice*—If a splice is used in the manufacture of the gasket, the strength shall be such that the gasket shall withstand 100 % elongation over the part of the gasket that includes the splice with no visible separation of the splice. While in the stretched position, the gasket shall be rotated in the spliced area a minimum of 180° in each direction in order to inspect for separation. Any portion of the splice shall be capable of passing a bend test without visible separation. The bend test for circular gaskets is defined as wrapping the portion of the unstretched gasket containing the splice a minimum of 180° and a maximum of 270° around a rod of a diameter equal to the cross section diameter of the gasket.

6.5.6 *Storage*—The gaskets shall be stored in a cool, clean, and shaded place, preferably at 21°C or less and in no case shall the gaskets be exposed to the direct rays of the sun for more than 72 h.

6.6 *Synthetic Fibers*—Collated fibrillated virgin polypropylene fibers are not prohibited in concrete pipe as a nonstructural manufacturing material. Only Type III synthetic fibers designed and manufactured specifically for use in concrete and conforming to the requirements of Specification C1116 shall be accepted.

7. Design

7.1 *Design Tables*—The standard dimensions shall be as given in Table 1. Wall thicknesses furnished shall be not less than those given in Table 1, except as affected by the tolerance specified in Section 12.

7.2 *Modified Design*—Manufacturers shall submit to the owner for approval prior to manufacture, wall thicknesses other than those shown in Table 1. Such pipe shall meet all of the test and performance requirements specified by the owner in accordance with 5.1.

8. Joints

8.1 Pipe units shall be manufactured with male- and female-type joints of such design that the rubber gasket applied thereto shall be the sole element depended upon to make the joints flexible and watertight.

8.2 The slope on the conic surfaces of the gasket seat on the inside of the female portion and on the outside of the male portion shall be not more than 3.5° measured from a longitudinal trace on the inside surface of the pipe. The female or the male portions, or both, shall form a proper gasket positioning area or "seat." The joint design shall be such that, when the joint has been fully closed and is off center sufficiently to cause the outer concrete surface of the male portion and the inner concrete surface of the female portion to come into contact at some place in the joint periphery, the deformation of the gasket adjacent to that point shall not exceed 50 % of the stretched diameter for O-ring gaskets, or 75 % of the uncompressed radial thickness for all other types. At the diametrically opposite side, the gasket deformation shall be not less than 15 % of the stretched diameter for O-ring gaskets, or 25 % of the uncompressed radial thickness for all other types. O-ring gaskets are defined as solid gaskets of circular cross section. Stretched gasket diameters shall be calculated as being $\sqrt{1/(1 + x)}$ times the original gasket diameter where x equals the percent of gasket stretch divided by 100.

8.3 The joint design shall provide for the deflection of each pipe unit by opening one side of the outside perimeter of the joint, wider than the fully closed position, a distance no less than 13 mm or 25 % of the wall thickness, whichever is less, without reducing its watertightness.

8.4 The joint shall be of such design that it will withstand, without cracking or fracturing, the forces caused by the compression of the gasket, and the required hydrostatic test pressure.

8.5 All surfaces of the joint upon or against which the gasket bear shall be smooth, free of spall, cracks, or fractures, and imperfections that would adversely affect performance.

8.6 *Alternative Joint Designs*—If permitted by the owner, manufacturers shall submit to the owner, detailed designs for joints and gaskets other than those described in 8.2, 8.3, 8.4, and 8.5. Design submissions shall include joint geometry tolerances, gasket characteristics, proposed plant tests, gasket splice bend tests, and such other information as required by the owner to evaluate the joint design for field performance. Joints and gaskets of alternative joint designs shall meet all test requirements of this specification unless waived by the owner. Alternative joint designs shall be acceptable provided the designs are approved by the owner prior to manufacture and provided the test pipe comply with the specified test.

9. Concrete Mixture

9.1 The aggregates shall be sized, graded, proportioned, and thoroughly mixed with such proportions of cementitious materials and water as will produce a homogeneous concrete mixture of such quality that the pipe will conform to the test and design