



Designation: **C505 – 11 C505 – 15**

# Standard Specification for Nonreinforced Concrete Irrigation Pipe with Rubber Gasket Joints<sup>1</sup>

This standard is issued under the fixed designation C505; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 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 A complete metric companion to Specification C505 has been developed—C505M; therefore, no SI equivalents are presented in this specification.

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*:<sup>2</sup>

~~C33~~[C33/C33M](#) Specification for Concrete Aggregates

~~C150~~[C150/C150M](#) Specification for Portland Cement

~~C260~~[C260M](#) Specification for Air-Entraining Admixtures for Concrete

~~C494~~[C494M](#) Specification for Chemical Admixtures for Concrete

~~C497~~ Test Methods for Concrete Pipe, Manhole Sections, or Tile

~~C595~~[C595/C595M](#) 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~~[C989/C989M](#) Specification for Slag Cement for Use in Concrete and Mortars

~~C1017~~[C1017M](#) Specification for Chemical Admixtures for Use in Producing Flowing Concrete

~~C1116~~[C1116M](#) Specification for Fiber-Reinforced Concrete and Shotcrete

~~C1602~~[C1602M](#) Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

~~D395~~ Test Methods for Rubber Property—Compression Set

~~D412~~ Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

~~D471~~ Test Method for Rubber Property—Effect of Liquids

~~D573~~ Test Method for Rubber—Deterioration in an Air Oven

~~D1149~~ Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment

~~D1415~~ Test Method for Rubber Property—International Hardness

~~D2240~~ Test Method for Rubber Property—Durometer 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.”

<sup>1</sup> 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 and Irrigation Pipe.

Current edition approved ~~Sept. 1, 2011~~ Oct. 1, 2015. Published ~~October 2011~~ October 2015. Originally approved in 1963. Last previous edition approved in ~~2005~~ 2011 as ~~C505 – 05a~~ C505 – 11. DOI: ~~10.1520/C0505-11~~ 10.1520/C0505-15.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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**

Internal Designated Diameter, in.	Wall Thickness, <sup>A</sup> in.	Working Pressure, <sup>B</sup> ft	Required Hydrostatic Test Pressure, <sup>C</sup> psi	Minimum Three-Edge-Bearing Load, lbf/linear ft
6	3/4	30	40	1300
8	1	30	40	1350
10	1 1/4	30	40	1400
12	1 1/2	30	40	1500
15	1 7/8	30	40	1650
18	2 1/4	30	40	1800
21	2 5/8	30	40	1900
24	3	30	40	2000

<sup>A</sup> Thinner walls are not prohibited on pipe units not over 4 ft in length, but the thickness of such walls shall not be less than the internal diameter divided by 10.

<sup>B</sup> With the exception of 21 and 24-in. pipe, higher working pressures are not prohibited to be used up to a maximum of 50 ft for 6 through 12-in. diameters, and 40 ft for 15 through 18-in. 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.

<sup>C</sup> For hydrostatic test requirements, refer to 10.4.

## 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.

## 6. Materials and Manufacture

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

### 6.2 Cementitious Materials:

6.2.1 *Cement*—Cement shall conform to the requirements for portland cement of Specification ~~C150/C150M~~ or shall be portland blast-furnace slag cement, or slag-modified portland-cement, or portland-limestone cement, or portland-pozzolan cement conforming to the requirements of Specification ~~C595/C595M~~, 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 Specification C618, Class F or Class C.

6.2.3 *Ground Granulated Blast Furnace Slag (GGBFS)*—~~Slag Cement~~—GGBFS Slag cement shall conform to the requirements of Grade 100 or 120 of Specification ~~C989/C989M~~.

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-pozzolan cement only,

6.2.4.4 Portland-pozzolan-Portland-limestone cement only,

6.2.4.5 A combination of portland cement or portland-limestone cement and fly ash,

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

6.2.4.7 A combination of portland cement or portland-limestone 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) and slag cement, or

6.2.4.8 A combination of portland-pozzolan cement and fly ash.

6.3 *Aggregates*—Aggregates shall conform to the requirements of Specification ~~C33/C33M~~, except that the requirements for gradation shall not apply.

6.4 *Admixtures and Blends*—~~Admixtures~~—Owner is not prohibited from obtaining the record of mix design used. The following admixtures and blends are allowable:

6.4.1 Air-entraining admixture conforming to Specification C260/C260M;

6.4.2 Chemical admixture conforming to Specification C494/C494M;

6.4.3 Chemical admixture for use in producing flowing concrete conforming to Specification C1017/C1017M; and

6.4.4 Chemical admixture or blend approved by the owner.

## 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*<sup>3</sup> 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 <sup>A</sup>	40 to 60
Compression set, max, %	25
Water absorption, %	10
Ozone resistance	no cracks in accordance with Test Method <b>D1149</b>

<sup>A</sup> Allowable variation  $\pm 5$  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 70°F 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. Synthetic fibers and nonsynthetic fibers shall be allowed to be used, at the manufacturer's option, in concrete pipe as a nonstructural manufacturing material. Only Type III synthetic fibers—Synthetic fibers (Type II and Type III) and nonsynthetic fiber (Type I) designed and manufactured specifically for use in concrete and conforming to the requirements of Specification **C1116/C1116M** shall be accepted.

6.7 *Water*—Water used in the production of concrete shall be potable or non-potable water that meets the requirements of Specification **C1602/C1602M**.

## 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

<sup>3</sup> Available from the Rubber Manufacturers Assn., Inc., 1400 K St., NW, suite 900, Washington DC, 20005.