



Designation: C 361M – 05

Standard Specification for Reinforced Concrete Low-Head Pressure Pipe (Metric)¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers reinforced concrete pipe intended to be used for the construction of pressure pipelines with low internal hydrostatic heads generally not exceeding 375 kPa.

1.2 This metric specification is the equivalent to Specification C 361 and is compatible in technical content.

NOTE 1—Field tests on completed portions of the pipeline are not covered by this specification for the manufacture of the pipe but should be included in specifications for pipe laying.

2. Referenced Documents

2.1 ASTM Standards:²

- A 27/A 27M Specification for Steel Castings, Carbon, for General Application
- A 36/A 36M Specification for Carbon Structural Steel
- A 82/A 82M Specification for Steel Wire, Plain, for Concrete Reinforcement
- A 185/A 185M Specification for Steel Welded Wire, Reinforcement, Plain, for Concrete
- A 283/A 283M Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
- A 496/A 496M Specification for Steel Wire Reinforcement, Deformed, for Concrete
- A 497/A 497M Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
- A 570/A 570M Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled³
- A 575 Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
- A 576 Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality

¹ This specification is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.04 on Low Head Pressure 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.

³ Withdrawn.

- A 611 Specification for Structural Steel, Sheet, Carbon, Cold-Rolled³
- A 615 Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- A 675/A 675M Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality; Mechanical Properties
- C 31/C 31M Practice for Making and Curing Concrete Test Specimens in the Field
- C 33 Specification for Concrete Aggregates
- C 39/C 39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C 150 Specification for Portland Cement
- C 260 Specification for Air-Entraining Admixtures for Concrete
- C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- C 497M Test Methods for Concrete Pipe, Manhole Sections, or Tile (Metric)
- C 595 Specification for Blended Hydraulic Cements
- C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- C 822 Terminology Relating to Concrete Pipe and Related Products
- D 395 Test Methods for Rubber Property—Compression Set
- D 412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- D 471 Test Method for Rubber Property—Effect of Liquids
- D 573 Test Method for Rubber—Deterioration in an Air Oven
- D 698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))
- D 1149 Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber
- D 2240 Test Method for Rubber Property—Durometer Hardness
- D 4253 Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

D 4254 Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

2.2 *Other Standard:*

ACI Code 318 Standard Building Code Requirements for Reinforced Concrete⁴
AISI-C1012⁵

3. Terminology

3.1 *Definitions*—For definitions of terms relating to concrete pipe, see Terminology **C 822**.

4. Classification

4.1 Pipe manufactured according to this specification shall be for hydrostatic heads of 75, 150, 225, 300, and 375 kPa measured to the centerline of the pipe. Designs are provided in **Table 1** for the above hydrostatic heads combined with external loadings of 1.5, 3.0, 4.5, and 6.0 (designated A, B, C, and D in **Table 1**) of earth cover over the top of the pipe under specific installation conditions. The specific installation conditions are covered in **Appendix X1**. Where the hydrostatic head, external loadings, and installation conditions vary from those given in **Table 1** and **Appendix X1**, detailed design calculations shall be made. The design criteria for **Table 1** are presented in **Appendix X2**.

5. Basis of Acceptance

5.1 Acceptability of the pipe in all diameters and classes shall be determined by the results of such material tests as are required in 6.2 through 6.9 by crushing tests on cured concrete cylinders, by hydrostatic pressure tests on units of the pipe, by joint leakage tests, and by inspection during or after manufacture to determine whether the pipe conforms to this specification as to design and freedom from defects.

5.2 *Age for Acceptance*—Pipe shall be considered ready for acceptance when they conform to the requirements, as indicated by the specified tests.

6. Materials

6.1 *Reinforced Concrete*—The reinforced concrete shall consist of portland cement, mineral aggregates, and water, in which steel has been embedded in such a manner that the steel and concrete act together. Fly ash or pozzolan is not prohibited when used as a partial cement replacement; see 9.1.

6.2 *Cementitious Materials:*

6.2.1 *Cement:*

6.2.1.1 *Portland Cement*—Portland cement shall conform to the requirements of Specification **C 150**.

6.2.1.2 *Blended Cement*—Blended cement shall conform to the requirements of Specification **C 595** for Type IS portland blast furnace slag cement or Type IP portland pozzolan cement, except that the pozzolan constituent in the Type IP portland pozzolan cement shall not exceed 20 % by weight.

6.2.2 *Fly Ash or Pozzolan*—Fly ash or pozzolan shall conform to the requirements of Specification **C 618**.

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

6.2.3.1 Portland cement only,

6.2.3.2 Portland blast furnace slag cement only,

6.2.3.3 Portland pozzolan cement only, or

6.2.3.4 A combination of portland cement and fly ash or pozzolan, wherein the proportion of fly ash or pozzolan is between 5 and 20 % by weight of total cementitious material (portland cement plus fly ash or pozzolan).

6.3 *Aggregates*—Aggregates shall conform to Specification **C 33**, except that the requirements for grading are waived.

6.4 *Admixtures*—Admixtures, except for air-entraining agents, shall not be added to the concrete unless permitted by the owner. At the option of the manufacturer, or if specified by the owner, the concrete in precast concrete pipe placed by the cast-and-vibrated method shall contain an air-entraining agent conforming to Specification **C 260**. The amount of air-entraining agent used shall be such as will affect the entrainment of not more than 3 % air by volume of concrete as discharged from the mixer.

6.5 *Steel Reinforcement*—Reinforcement shall consist of wire conforming to Specification A 82, Specification A 496, or of wire fabric conforming to Specification A 185 or Specification A 497, or of bars of Grade 300 steel conforming to Specification **A 615/A 615M**.

6.6 *Steel for Joint Rings:*

6.6.1 Steel strips for bell rings less than 6 mm thick shall conform to Grade 30 of Specification A 570/A 570M or Grade Designation 1012 of Specification **A 575**. Steel that meets the requirements of AISI-C1012 for chemical components will be acceptable provided it conforms to Grade 30 of Specification A 570/A 570M in other respects.

6.6.2 Steel plate for bell rings 6 mm or more in thickness and special shapes for spigot joint rings shall conform to Specification A 36/A 36M, or to Grade A of Specification A 283/A 283M, or to Grade Designation 1012 of Specification **A 576**, or to Grade 50 of Specification A 675/A 675M. Steel that meets the requirements of AISI-C1012 for chemical components will be acceptable provided it conforms to Specification A 36/A 36M or to Specification A 283/A 283M in other respects.

6.7 *Steel Castings for Fittings*—Steel castings for fittings shall conform to Grade 70-36, Normalized, of Specification A 27/A 27M.

6.8 *Steel Plates and Sheets for Specials and Fittings*—Steel plates for specials and fittings shall conform to Specification A 36/A 36M or to Grade B or C of Specification A 283/A 283M or Grade 30 or 33 of Specification A 570/A 570M or Grade B of Specification **A 611**.

6.9 *Rubber Gaskets:*

6.9.1 *Composition and Properties*—All rubber gaskets shall be extruded or molded and cured in such a manner that any cross section will be dense, homogeneous, and free of porosity, blisters, pitting, and other imperfections. The gaskets shall be of a solid circular cross section and shall be extruded or molded

⁴ Available from the American Concrete Institute, 38800 Country Club Dr., Farmington Hills, MI 48331.

⁵ Available from the Iron and Steel Institute, 1140 Connecticut Ave., Suite 705, Washington D.C. 20036.