



Designation: C361 – 14a

Standard Specification for Reinforced Concrete Low-Head Pressure Pipe¹

This standard is issued under the fixed designation C361; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

This standard has been approved for use by agencies of the U.S. 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 125 ft.

1.2 This specification is the inch-pound companion to Specification C361; therefore, no SI equivalents are presented in the specification.

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

[A27/A27M](#) Specification for Steel Castings, Carbon, for General Application

[A36/A36M](#) Specification for Carbon Structural Steel

[A283/A283M](#) Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

[A575](#) Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

[A576](#) Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality

[A615/A615M](#) Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

[A675/A675M](#) Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties

[A706/A706M](#) Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

[A1008/A1008M](#) Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

[A1011/A1011M](#) Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

[A1064/A1064M](#) Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

[C31/C31M](#) Practice for Making and Curing Concrete Test Specimens in the Field

[C33](#) Specification for Concrete Aggregates

[C39/C39M](#) Test Method for Compressive Strength of Cylindrical Concrete Specimens

[C150](#) Specification for Portland Cement

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

[C309](#) Specification for Liquid Membrane-Forming Compounds for Curing Concrete

[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

[C655](#) Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe

[C822](#) Terminology Relating to Concrete Pipe and Related Products

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

[C1619](#) Specification for Elastomeric Seals for Joining Concrete Structures

[D698](#) Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))

[D4253](#) Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

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.

Current edition approved April 1, 2014. Published April 2014. Originally approved in 1955. Last previous edition approved in 2014 as C361 – 14. DOI: 10.1520/C0361-14A.

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.

D4254 Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

2.2 *Other Standards:*

ACI Code 318 Standard Building Code Requirements for Reinforced Concrete³

AISI-C 1012⁴

ASCE 15-93 Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD)

3. Terminology

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

4. Classification

4.1 Pipe manufactured according to this specification shall be for hydrostatic heads of 25, 50, 75, 100, and 125 ft measured to the centerline of the pipe. Designs are provided in **Table 1** for the above hydrostatic heads combined with external loadings of 5, 10, 15, and 20 ft (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 **C150**.

6.2.1.2 *Blended Hydraulic Cement*—Blended cement shall conform to the requirements of Specification **C595** for Type IS portland blast furnace slag cement or Type IP portland pozzo-

lan 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 **C618**.

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, or

6.2.3.3 Portland pozzolan cement only.

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 **C33**, 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 **C260**. 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 **A1064/A1064M**, or of bars of Grades 40 or 60 steel conforming to Specification **A615/A615M** or of Grade 40 steel conforming to Specification **A36/A36M**, or Grade 60 steel conforming to Specification **A706/A706M**.

6.6 *Steel for Joint Rings:*

6.6.1 Steel strips for bell rings less than ¼ in. thick shall conform to Grade SS30 of Specification **A1011/A1011M** or Grade Designation 1012 of Specification **A575**. Steel that meets the requirements of AISI-C1012 for chemical components will be acceptable provided it conforms to Grade SS30 of Specification **A1011/A1011M** in other respects.

6.6.2 Steel plate for bell rings ¼ in. or more in thickness and special shapes for spigot joint rings shall conform to Specification **A36/A36M**, or to Grade A of Specification **A283/A283M**, or to Grade Designation 1012 of Specification **A576**, or to Grade 50 of Specification **A675/A675M**. Steel that meets the requirements of AISI-C1012 for chemical components will be acceptable provided it conforms to Specification **A36/A36M** or to Specification **A283/A283M** Min other respects.

6.7 *Steel Castings for Fittings*—Steel castings for fittings shall conform to Grade 70-36, Normalized, of Specification **A27/A27M**.

6.8 *Steel Plates and Sheets for Specials and Fittings*—Steel plates for specials and fittings shall conform to Specification **A36/A36M** or to Grade B or C of Specification **A283/A283M** or Grade SS30 or SS33 of Specification **A1011/A1011M** or Grade SS30 of Specification **A1008/A1008M**.

6.9 *Rubber Gaskets:*

³ Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, <http://www.concrete.org>.

⁴ Available from American Iron and Steel Institute (AISI), 1140 Connecticut Ave., NW, Suite 705, Washington, DC 20036, <http://www.steel.org>.

TABLE 1 Continued

Internal Designated Dia., in.	Circumferential reinforcement, in. ² /linear ft. of pipe																		
	30						33												
Type of Reinforcement	Circular						Elliptical												
	2 3/4	3 1/6	3 1/4	3 1/2	4 3/4	3 1/2	2 3/4	3 1/2	3 3/4	3 1/4	3 3/4	4 3/4	2 7/8	3 3/4					
Wall Thickness, in.	Single	Single	Inner	Outer	Inner	Outer	Single	Single	Inner	Outer	Inner	Outer	Single	Single					
	Single	Single	Inner	Outer	Inner	Outer	Single	Single	Inner	Outer	Inner	Outer	Single	Single					
Layers of Reinforcement	Single	Single	Inner	Outer	Inner	Outer	Single	Single	Inner	Outer	Inner	Outer	Single	Single					
	Single	Single	Inner	Outer	Inner	Outer	Single	Single	Inner	Outer	Inner	Outer	Single	Single					
Class																			
A-25	0.25	0.23	0.16	0.11	0.15	0.10	0.08	0.25	0.19	0.29	0.27	0.19	0.13	0.17	0.11	0.14	0.09	0.29	0.21
B-25	0.41	0.37	0.25	0.16	0.23	0.15	0.11	0.41	0.23	0.48	0.45	0.30	0.19	0.26	0.16	0.21	0.13	0.48	0.26
C-25	0.60	0.52	0.34	0.21	0.31	0.19	0.13	0.60	0.31	0.71	0.64	0.41	0.25	0.34	0.21	0.27	0.16	0.71	0.34
D-25	0.82	0.69	0.44	0.26	0.40	0.23	0.16	0.82	0.40	0.92	0.87	0.53	0.32	0.44	0.26	0.34	0.19	0.92	0.44
A-50	0.32	0.30	0.21	0.16	0.20	0.15	0.13	0.41	0.41	0.37	0.35	0.24	0.19	0.22	0.17	0.19	0.15	0.45	0.45
B-50	0.49	0.45	0.30	0.21	0.28	0.20	0.15	0.49	0.41	0.56	0.53	0.35	0.25	0.31	0.22	0.26	0.18	0.56	0.45
C-50	0.67	0.60	0.39	0.26	0.36	0.24	0.18	0.67	0.41	0.79	0.72	0.46	0.31	0.40	0.26	0.32	0.21	0.79	0.45
D-50	0.90	0.77	0.49	0.31	0.44	0.28	0.20	0.90	0.44	1.00	0.95	0.58	0.37	0.49	0.31	0.39	0.24	1.00	0.49
A-75	0.41	0.41	0.27	0.22	0.25	0.21	0.18	0.45	0.30	0.45	0.45	0.30	0.24	0.27	0.22	0.25	0.20	0.45	0.45
B-75	0.56	0.52	0.35	0.26	0.33	0.25	0.20	0.64	0.41	0.64	0.61	0.41	0.30	0.36	0.27	0.31	0.23	0.64	0.45
C-75	0.74	0.67	0.44	0.31	0.41	0.29	0.22	0.87	0.52	0.87	0.80	0.52	0.36	0.45	0.32	0.37	0.26	0.87	0.45
D-75	0.97	0.84	0.53	0.36	0.49	0.33	0.25	1.08	0.63	1.08	1.03	0.63	0.43	0.54	0.36	0.44	0.29	1.08	0.49
A-100	0.58	0.58	0.32	0.27	0.31	0.26	0.27	0.64	0.36	0.64	0.64	0.46	0.30	0.34	0.29	0.34	0.29	0.64	0.45
B-100	0.63	0.59	0.41	0.31	0.38	0.30	0.25	0.72	0.47	0.72	0.69	0.47	0.36	0.42	0.32	0.36	0.28	0.72	0.45
C-100	0.82	0.74	0.49	0.36	0.46	0.34	0.27	0.95	0.57	0.95	0.88	0.57	0.42	0.50	0.37	0.42	0.31	0.95	0.45
D-100	1.04	0.91	0.58	0.41	0.54	0.38	0.29	1.16	0.69	1.16	1.11	0.69	0.48	0.59	0.42	0.49	0.34	1.16	0.49
A-125	0.77	0.77	0.41	0.36	0.41	0.36	0.41	0.85	0.46	0.85	0.85	0.46	0.39	0.45	0.39	0.45	0.40	0.85	0.45
B-125	0.77	0.77	0.46	0.37	0.43	0.35	0.35	0.85	0.52	0.85	0.85	0.52	0.42	0.47	0.38	0.47	0.38	0.85	0.45
C-125	0.89	0.81	0.54	0.41	0.51	0.39	0.33	1.03	0.63	1.03	0.96	0.63	0.48	0.56	0.42	0.54	0.37	1.03	0.45
D-125	1.12	0.99	0.63	0.46	0.59	0.43	0.34	1.24	0.74	1.24	1.19	0.74	0.54	0.65	0.47	0.54	0.39	1.24	0.49

TABLE 1 Continued

Internal Designated Dia., in.	Circumferential reinforcement, in. ² /linear ft. of pipe																													
	36						39						42																	
	Circular			Elliptical			Circular			Elliptical			Circular		Elliptical															
Wall Thickness, in.	4		5		3 1/6		4		3 1/2		4 1/4		5 1/4		3 1/2		4 1/4		3 3/4		5 1/2		4 1/2		3 3/4		4 1/2			
Layers of Reinforcement	Single	Inner	Outer	Inner	Outer	Single	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Single	Inner	Outer	Single	Inner	Outer	Inner	Outer	Inner	Outer	Single	Inner	Outer	Single		
Class	0.32	0.22	0.15	0.18	0.12	0.15	0.10	0.32	0.23	0.23	0.16	0.20	0.13	0.17	0.11	0.25	0.25	0.25	0.17	0.21	0.15	0.19	0.13	0.27	0.27	0.21	0.17	0.40	0.33	
A-25	0.54	0.35	0.23	0.28	0.18	0.23	0.14	0.54	0.38	0.38	0.24	0.31	0.19	0.26	0.16	0.38	0.31	0.38	0.40	0.33	0.21	0.28	0.17	0.40	0.40	0.33	0.21	0.40	0.33	
B-25	0.78	0.49	0.30	0.38	0.23	0.30	0.18	0.78	0.38	0.52	0.32	0.41	0.25	0.34	0.20	0.52	0.41	0.55	0.34	0.45	0.27	0.37	0.22	0.55	0.55	0.45	0.27	0.55	0.45	
C-25	1.01	0.63	0.38	0.48	0.28	0.38	0.21	1.01	0.48	0.67	0.40	0.52	0.31	0.42	0.24	0.67	0.52	0.71	0.43	0.56	0.34	0.46	0.26	0.71	0.71	0.56	0.34	0.71	0.56	
D-25	0.40	0.28	0.21	0.24	0.18	0.21	0.16	0.49	0.49	0.30	0.23	0.26	0.20	0.23	0.17	0.53	0.53	0.32	0.24	0.28	0.21	0.25	0.19	0.57	0.57	0.28	0.21	0.57	0.57	
A-50	0.62	0.41	0.29	0.34	0.24	0.29	0.20	0.62	0.49	0.44	0.31	0.37	0.26	0.31	0.22	0.53	0.53	0.47	0.32	0.40	0.28	0.34	0.24	0.57	0.57	0.40	0.28	0.57	0.57	
B-50	0.87	0.54	0.36	0.43	0.29	0.36	0.23	0.87	0.49	0.58	0.38	0.47	0.31	0.39	0.25	0.58	0.53	0.61	0.41	0.51	0.34	0.43	0.28	0.61	0.61	0.51	0.34	0.61	0.57	
C-50	1.10	0.69	0.44	0.53	0.34	0.43	0.27	1.10	0.53	0.73	0.47	0.58	0.37	0.47	0.30	0.73	0.58	0.77	0.49	0.63	0.40	0.52	0.32	0.77	0.77	0.63	0.40	0.77	0.63	
D-50	0.49	0.34	0.28	0.30	0.24	0.27	0.22	0.49	0.49	0.36	0.29	0.32	0.26	0.29	0.24	0.53	0.53	0.38	0.31	0.34	0.28	0.31	0.25	0.38	0.38	0.34	0.28	0.31	0.25	
A-75	0.71	0.47	0.35	0.40	0.29	0.34	0.25	0.71	0.49	0.50	0.37	0.43	0.32	0.37	0.28	0.53	0.53	0.53	0.39	0.46	0.34	0.41	0.30	0.53	0.53	0.46	0.34	0.53	0.47	
B-75	0.96	0.60	0.42	0.49	0.34	0.41	0.29	0.96	0.49	0.64	0.45	0.53	0.37	0.45	0.31	0.64	0.53	0.68	0.47	0.57	0.40	0.49	0.34	0.68	0.68	0.57	0.40	0.68	0.61	
C-75	1.19	0.74	0.50	0.59	0.40	0.48	0.32	1.19	0.53	0.79	0.53	0.64	0.43	0.53	0.35	0.79	0.58	0.83	0.56	0.69	0.46	0.58	0.39	0.83	0.83	0.69	0.46	0.83	0.77	
D-75	0.69	0.40	0.34	0.38	0.32	0.38	0.32	0.69	0.49	0.43	0.36	0.41	0.34	0.41	0.34	0.53	0.53	0.45	0.38	0.44	0.37	0.44	0.37	0.45	0.45	0.44	0.37	0.45	0.39	
A-100	0.80	0.53	0.41	0.45	0.35	0.40	0.31	0.80	0.49	0.57	0.44	0.49	0.38	0.43	0.33	0.64	0.64	0.60	0.46	0.53	0.41	0.47	0.36	0.60	0.60	0.53	0.41	0.60	0.55	
B-100	1.04	0.66	0.48	0.55	0.40	0.47	0.34	1.04	0.49	0.70	0.51	0.59	0.43	0.51	0.37	0.74	0.74	0.74	0.54	0.64	0.46	0.55	0.40	0.74	0.74	0.64	0.46	0.74	0.61	
C-100	1.28	0.80	0.56	0.65	0.45	0.54	0.38	1.28	0.49	0.85	0.59	0.70	0.49	0.59	0.41	0.90	0.90	0.90	0.63	0.75	0.53	0.64	0.45	0.90	0.90	0.75	0.53	0.90	0.77	
D-100	0.93	0.50	0.43	0.50	0.43	0.50	0.43	0.93	0.49	0.54	0.46	0.54	0.47	0.54	0.47	0.64	0.64	0.58	0.50	0.58	0.50	0.58	0.50	0.58	0.58	0.50	0.58	0.50	0.58	
A-125	0.93	0.60	0.47	0.51	0.41	0.51	0.41	0.93	0.49	0.63	0.50	0.56	0.45	0.56	0.45	0.67	0.67	0.67	0.53	0.60	0.48	0.60	0.48	0.67	0.67	0.60	0.48	0.67	0.61	
B-125	1.13	0.72	0.54	0.60	0.46	0.53	0.40	1.13	0.49	0.77	0.58	0.65	0.49	0.57	0.43	0.81	0.81	0.81	0.61	0.70	0.53	0.62	0.47	0.81	0.81	0.70	0.53	0.81	0.62	
C-125	1.36	0.86	0.62	0.70	0.51	0.59	0.43	1.36	0.49	0.91	0.65	0.76	0.55	0.65	0.47	0.96	0.96	0.96	0.69	0.81	0.59	0.70	0.51	0.96	0.96	0.81	0.59	0.96	0.70	
D-125																														

TABLE 1 Continued

Internal Designated Dia, in.	Circumferential reinforcement, in. ² /linear ft. of pipe																									
	45						48						51													
	Circular			Elliptical			Circular			Elliptical			Circular		Elliptical											
Type of Reinforcement	3 ⁷ / ₈		4 ³ / ₄		5 ³ / ₄		3 ⁷ / ₈		4 ³ / ₄		5 ³ / ₄		4 ¹ / ₂		5 ³ / ₄		4 ¹ / ₂		5 ³ / ₄							
Wall Thickness, in.	Outer		Inner		Outer		Inner		Outer		Inner		Outer		Inner		Outer		Inner							
Layers of Reinforcement	Inner		Outer		Inner		Outer		Inner		Outer		Inner		Outer		Inner		Outer							
Class	0.27	0.19	0.23	0.16	0.20	0.14	0.29	0.29	0.29	0.29	0.20	0.25	0.17	0.23	0.15	0.31	0.31	0.32	0.22	0.27	0.18	0.25	0.17	0.33	0.33	0.33
A-25	0.44	0.28	0.36	0.23	0.31	0.19	0.44	0.36	0.41	0.39	0.25	0.35	0.22	0.48	0.39	0.48	0.52	0.33	0.33	0.42	0.26	0.37	0.23	0.33	0.52	0.42
B-25	0.60	0.38	0.48	0.29	0.40	0.24	0.60	0.48	0.65	0.41	0.53	0.32	0.46	0.27	0.65	0.53	0.71	0.44	0.56	0.34	0.49	0.30	0.49	0.30	0.71	0.56
C-25	0.78	0.47	0.61	0.36	0.50	0.29	0.78	0.61	0.84	0.51	0.66	0.40	0.57	0.33	0.84	0.66	0.92	0.56	0.71	0.42	0.62	0.36	0.62	0.36	0.92	0.71
D-25	0.34	0.26	0.30	0.23	0.27	0.20	0.61	0.61	0.37	0.28	0.32	0.25	0.30	0.23	0.65	0.65	0.40	0.30	0.35	0.26	0.32	0.24	0.32	0.24	0.70	0.70
A-50	0.51	0.35	0.43	0.30	0.37	0.26	0.61	0.61	0.55	0.38	0.47	0.32	0.42	0.29	0.65	0.65	0.60	0.41	0.50	0.34	0.45	0.31	0.45	0.31	0.70	0.70
B-50	0.67	0.45	0.55	0.36	0.47	0.30	0.67	0.61	0.73	0.48	0.60	0.39	0.53	0.34	0.73	0.65	0.79	0.52	0.64	0.42	0.57	0.37	0.57	0.37	0.79	0.70
C-50	0.85	0.54	0.67	0.43	0.56	0.35	0.85	0.67	0.91	0.59	0.73	0.47	0.64	0.40	0.91	0.73	0.99	0.64	0.78	0.50	0.69	0.43	0.69	0.43	0.99	0.78
D-50	0.42	0.33	0.37	0.30	0.34	0.27	0.45	0.45	0.36	0.28	0.32	0.25	0.30	0.23	0.65	0.65	0.48	0.38	0.42	0.34	0.40	0.32	0.40	0.32	0.70	0.70
A-75	0.58	0.43	0.50	0.37	0.44	0.32	0.63	0.46	0.54	0.40	0.54	0.40	0.49	0.36	0.68	0.68	0.68	0.50	0.57	0.42	0.52	0.38	0.52	0.38	0.70	0.70
B-75	0.74	0.52	0.61	0.43	0.53	0.37	0.80	0.56	0.67	0.47	0.67	0.47	0.60	0.42	0.86	0.86	0.86	0.60	0.71	0.50	0.64	0.45	0.64	0.45	0.79	0.70
C-75	0.91	0.61	0.74	0.50	0.63	0.42	0.98	0.66	0.80	0.66	0.80	0.54	0.71	0.47	1.07	0.73	1.07	0.71	0.85	0.57	0.76	0.51	0.76	0.51	0.99	0.78
D-75	0.49	0.41	0.47	0.39	0.47	0.40	0.53	0.44	0.53	0.44	0.50	0.42	0.50	0.42	0.56	0.56	0.56	0.47	0.54	0.45	0.53	0.45	0.53	0.45	0.71	0.71
A-100	0.65	0.50	0.57	0.43	0.51	0.39	0.70	0.54	0.61	0.47	0.61	0.47	0.56	0.43	0.76	0.76	0.76	0.68	0.65	0.50	0.60	0.46	0.60	0.46	0.73	0.73
B-100	0.81	0.59	0.68	0.50	0.60	0.44	0.87	0.63	0.74	0.54	0.67	0.54	0.67	0.49	0.94	0.94	0.94	0.79	0.79	0.57	0.72	0.52	0.72	0.52	0.79	0.79
C-100	0.98	0.68	0.80	0.56	0.69	0.48	1.05	0.73	0.87	0.61	0.78	0.61	0.78	0.54	1.14	0.93	1.14	0.79	0.93	0.65	0.83	0.58	0.83	0.58	0.99	0.99
D-100	0.62	0.53	0.62	0.54	0.62	0.54	0.67	0.57	0.66	0.57	0.66	0.57	0.66	0.57	0.71	0.71	0.71	0.60	0.71	0.61	0.71	0.61	0.71	0.61	0.71	0.71
A-125	0.73	0.57	0.64	0.51	0.64	0.51	0.78	0.62	0.69	0.55	0.69	0.55	0.69	0.55	0.84	0.84	0.84	0.66	0.73	0.58	0.73	0.58	0.73	0.58	0.73	0.73
B-125	0.88	0.66	0.75	0.57	0.66	0.50	0.95	0.71	0.81	0.61	0.74	0.56	0.74	0.56	1.02	1.02	1.02	0.86	0.86	0.65	0.86	0.65	0.86	0.65	0.79	0.79
C-125	1.05	0.75	0.87	0.63	0.76	0.55	1.13	0.81	0.94	0.68	0.85	0.62	0.85	0.62	1.21	1.21	1.21	0.87	1.00	0.72	0.91	0.66	0.91	0.66	0.91	0.91
D-125	0.27	0.19	0.23	0.16	0.20	0.14	0.29	0.29	0.29	0.20	0.25	0.17	0.23	0.15	0.31	0.31	0.32	0.22	0.27	0.18	0.25	0.17	0.33	0.33	0.33	0.33

TABLE 1 Continued

Internal Designated Dia., in.		Circumferential reinforcement, in. ² /linear ft. of pipe																					
		54						57						60									
Type of Reinforcement	Circular						Circular						Elliptical		Circular		Elliptical						
	4½		5½		6¼		4½		5½		6½		4¾		5¾		6¾		5		6		
Wall Thickness, in.	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Single	Single	Inner	Outer	Inner	Outer	Single	Single	
Class																							
A-25	0.33	0.23	0.29	0.19	0.26	0.18	0.35	0.35	0.35	0.24	0.30	0.21	0.28	0.19	0.37	0.37	0.37	0.25	0.32	0.22	0.30	0.20	0.39
B-25	0.54	0.35	0.44	0.28	0.40	0.25	0.54	0.44	0.44	0.36	0.47	0.30	0.42	0.26	0.56	0.47	0.58	0.38	0.49	0.31	0.45	0.28	0.58
C-25	0.74	0.46	0.60	0.36	0.53	0.32	0.74	0.60	0.78	0.49	0.63	0.39	0.57	0.34	0.78	0.63	0.81	0.51	0.67	0.41	0.60	0.36	0.81
D-25	0.96	0.59	0.75	0.45	0.66	0.39	0.96	0.75	1.00	0.61	0.80	0.48	0.70	0.41	1.00	0.80	1.05	0.64	0.85	0.51	0.75	0.44	1.05
A-50	0.42	0.31	0.37	0.28	0.34	0.26	0.74	0.74	0.44	0.33	0.39	0.29	0.37	0.27	0.78	0.78	0.46	0.35	0.41	0.31	0.39	0.29	0.82
B-50	0.62	0.43	0.52	0.36	0.48	0.33	0.74	0.74	0.65	0.45	0.55	0.38	0.50	0.35	0.78	0.78	0.67	0.47	0.58	0.40	0.53	0.37	0.82
C-50	0.82	0.55	0.68	0.44	0.61	0.40	0.82	0.74	0.86	0.57	0.72	0.47	0.65	0.42	0.86	0.78	0.90	0.60	0.76	0.50	0.69	0.45	0.90
D-50	1.04	0.66	0.83	0.53	0.74	0.46	1.04	0.83	1.08	0.69	0.88	0.56	0.78	0.49	1.08	0.88	1.13	0.72	0.93	0.59	0.83	0.53	1.13
A-75	0.50	0.40	0.45	0.36	0.42	0.34	0.53	0.53	0.42	0.48	0.38	0.45	0.36	0.36	0.55	0.55	0.55	0.44	0.50	0.40	0.48	0.38	0.82
B-75	0.71	0.52	0.60	0.44	0.55	0.41	0.73	0.54	0.63	0.47	0.59	0.43	0.59	0.43	0.76	0.76	0.76	0.56	0.67	0.49	0.62	0.45	0.82
C-75	0.90	0.63	0.75	0.52	0.68	0.47	0.94	0.66	0.80	0.66	0.80	0.55	0.73	0.50	0.99	0.99	0.99	0.68	0.84	0.58	0.77	0.53	0.90
D-75	1.11	0.74	0.91	0.61	0.81	0.54	1.16	0.78	0.96	0.78	0.96	0.64	0.86	0.58	1.21	1.21	1.21	0.81	1.01	0.68	0.91	0.61	1.13
A-100	0.59	0.49	0.57	0.47	0.57	0.47	0.62	0.51	0.60	0.51	0.60	0.50	0.60	0.50	0.65	0.65	0.65	0.53	0.63	0.52	0.63	0.52	0.82
B-100	0.79	0.60	0.68	0.52	0.63	0.49	0.82	0.63	0.72	0.55	0.67	0.51	0.67	0.51	0.85	0.85	0.85	0.65	0.76	0.58	0.71	0.54	0.82
C-100	0.98	0.71	0.83	0.61	0.76	0.55	1.03	0.74	0.88	0.64	0.81	0.59	0.81	0.59	1.07	1.07	1.07	0.77	0.93	0.67	0.86	0.62	0.90
D-100	1.19	0.83	0.98	0.69	0.89	0.62	1.24	0.86	1.04	0.72	0.94	0.66	0.94	0.66	1.29	1.29	1.29	0.90	1.09	0.76	1.00	0.70	0.82
A-125	0.75	0.64	0.75	0.64	0.75	0.64	0.79	0.67	0.79	0.68	0.79	0.68	0.79	0.68	0.84	0.84	0.84	0.71	0.83	0.71	0.83	0.71	0.83
B-125	0.87	0.69	0.77	0.61	0.77	0.62	0.91	0.71	0.82	0.65	0.82	0.65	0.82	0.65	0.94	0.94	0.94	0.74	0.86	0.68	0.86	0.68	0.82
C-125	1.07	0.79	0.91	0.69	0.84	0.63	1.11	0.83	0.96	0.72	0.89	0.67	0.89	0.67	1.16	1.16	1.16	0.86	1.02	0.76	0.94	0.71	0.82
D-125	1.27	0.91	1.06	0.77	0.97	0.70	1.32	0.95	1.12	0.81	1.02	0.74	1.02	0.74	1.38	1.38	1.38	0.99	1.18	0.85	1.08	0.78	0.82

TABLE 1 Continued

Internal Designated Dia., in.		Circumferential reinforcement, in. ² /linear ft. of pipe																							
		63						66						69											
Type of Reinforcement	Circular						Circular						Elliptical		Circular		Elliptical								
	5/4		6/4		7		5/2		6/2		7/4		5/2		6/2		5/4		7/2		5/4		6/4		
Wall Thickness, in.	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	
Class	0.39	0.27	0.35	0.24	0.32	0.22	0.41	0.28	0.37	0.25	0.34	0.23	0.43	0.43	0.43	0.30	0.39	0.26	0.36	0.24	0.44	0.44	0.44	0.44	
A-25	0.62	0.40	0.52	0.33	0.48	0.30	0.64	0.41	0.55	0.35	0.50	0.31	0.64	0.55	0.64	0.43	0.58	0.37	0.53	0.33	0.67	0.67	0.67	0.67	
B-25	0.87	0.54	0.72	0.44	0.65	0.39	0.87	0.56	0.76	0.46	0.60	0.41	0.90	0.76	0.90	0.58	0.80	0.49	0.72	0.44	0.94	0.94	0.94	0.94	
C-25	1.11	0.68	0.90	0.54	0.81	0.47	1.11	0.70	0.95	0.57	0.85	0.50	1.16	0.95	1.16	0.73	1.00	0.60	0.90	0.53	1.20	1.20	1.20	1.20	
D-25	0.49	0.37	0.44	0.33	0.42	0.31	0.86	0.51	0.47	0.35	0.44	0.33	0.90	0.90	0.90	0.40	0.49	0.36	0.46	0.34	0.94	0.94	0.94	0.94	
A-50	0.71	0.49	0.62	0.43	0.57	0.39	0.86	0.51	0.65	0.45	0.60	0.41	0.90	0.90	0.90	0.53	0.67	0.47	0.63	0.43	0.94	0.94	0.94	0.94	
B-50	0.96	0.63	0.81	0.53	0.74	0.48	0.96	0.66	0.85	0.56	0.78	0.51	1.00	0.90	1.00	0.68	0.89	0.59	0.82	0.53	1.04	1.04	1.04	1.04	
C-50	1.20	0.77	0.99	0.63	0.89	0.56	1.20	0.80	1.04	0.66	0.94	0.59	1.24	1.04	1.24	0.83	1.09	0.70	0.99	0.63	1.29	1.29	1.29	1.29	
D-50	0.59	0.47	0.54	0.43	0.51	0.40	0.62	0.49	0.56	0.45	0.54	0.42	0.64	0.64	0.64	0.51	0.59	0.47	0.56	0.45	0.94	0.94	0.94	0.94	
A-75	0.81	0.59	0.71	0.52	0.66	0.48	0.84	0.61	0.74	0.54	0.69	0.51	0.87	0.87	0.87	0.63	0.77	0.57	0.73	0.53	0.94	0.94	0.94	0.94	
B-75	1.05	0.73	0.90	0.62	0.83	0.57	1.09	0.76	0.94	0.65	0.87	0.60	1.13	1.13	1.13	0.78	0.99	0.69	0.92	0.63	1.04	1.04	1.04	1.04	
C-75	1.28	0.86	1.08	0.72	0.98	0.65	1.33	0.89	1.13	0.76	1.03	0.69	1.38	1.38	1.38	0.93	1.19	0.79	1.09	0.72	1.29	1.29	1.29	1.29	
D-75	0.69	0.57	0.66	0.55	0.66	0.55	0.72	0.59	0.70	0.57	0.70	0.57	0.75	0.75	0.75	0.61	0.73	0.60	0.73	0.60	0.96	0.96	0.96	0.96	
A-100	0.90	0.69	0.80	0.61	0.75	0.58	0.94	0.71	0.84	0.64	0.79	0.60	0.97	0.97	0.97	0.74	0.88	0.67	0.82	0.63	1.04	1.04	1.04	1.04	
B-100	1.14	0.82	0.99	0.72	0.92	0.66	1.19	0.85	1.04	0.75	0.96	0.70	1.23	1.23	1.23	0.89	1.09	0.78	1.01	0.73	1.29	1.29	1.29	1.29	
C-100	1.37	0.95	1.17	0.81	1.07	0.74	1.42	0.99	1.22	0.85	1.12	0.78	1.48	1.48	1.48	1.02	1.28	0.89	1.18	0.82	1.29	1.29	1.29	1.29	
D-100	0.88	0.74	0.88	0.74	0.88	0.74	0.92	0.78	0.92	0.78	0.92	0.78	0.96	0.96	0.96	0.81	0.96	0.81	0.96	0.81	1.04	1.04	1.04	1.04	
A-125	1.00	0.78	0.90	0.72	0.90	0.72	1.04	0.81	0.95	0.75	0.95	0.75	1.07	1.07	1.07	0.84	0.99	0.78	0.99	0.78	1.04	1.04	1.04	1.04	
B-125	1.23	0.92	1.08	0.81	1.01	0.75	1.28	0.95	1.13	0.85	1.06	0.79	1.33	1.33	1.33	0.99	1.19	0.89	1.11	0.83	1.04	1.04	1.04	1.04	
C-125	1.46	1.04	1.26	0.90	1.16	0.83	1.52	1.08	1.32	0.95	1.22	0.88	1.57	1.57	1.57	1.12	1.38	0.99	1.28	0.92	1.29	1.29	1.29	1.29	
D-125																									

TABLE 1 Continued

Internal Designated Dia., in.		Circumferential reinforcement, in. ² /linear ft. of pipe																		
		72						78						84						
Type of Reinforcement	Wall Thickness, in.	Circular						Circular						Circular						
		6		7		7 ³ / ₄		6		7		7 ¹ / ₂		8		8 ³ / ₄				
Layers of Reinforcement	Inner	Outer	Inner	Outer	Inner	Outer	Single	Single	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer				
																	Class	0.48	0.33	0.43
A-25	0.73	0.47	0.63	0.40	0.58	0.36	0.73	0.63	0.79	0.50	0.69	0.44	0.63	0.40	0.84	0.54	0.74	0.47	0.69	0.43
B-25	1.05	0.65	0.88	0.54	0.80	0.48	1.05	0.88	1.12	0.69	0.96	0.58	0.87	0.53	1.18	0.73	1.02	0.63	0.94	0.57
C-25	1.34	0.81	1.10	0.66	0.99	0.58	1.34	1.10	1.43	0.87	1.20	0.72	1.09	0.64	1.49	0.91	1.30	0.78	1.19	0.70
D-25	0.60	0.44	0.54	0.40	0.51	0.38	0.98	0.98	0.65	0.48	0.59	0.44	0.56	0.41	0.70	0.51	0.64	0.47	0.61	0.45
A-50	0.84	0.58	0.74	0.51	0.68	0.47	0.98	0.98	0.90	0.62	0.80	0.55	0.75	0.51	0.96	0.66	0.87	0.59	0.81	0.56
B-50	1.15	0.76	0.98	0.64	0.90	0.59	1.15	0.98	1.23	0.81	1.07	0.70	0.98	0.64	1.30	0.85	1.14	0.75	1.06	0.69
C-50	1.44	0.92	1.21	0.77	1.09	0.69	1.44	1.21	1.53	0.98	1.31	0.83	1.20	0.75	1.61	1.03	1.42	0.90	1.30	0.82
D-50	0.71	0.56	0.65	0.51	0.62	0.49	0.98	0.98	0.77	0.60	0.71	0.55	0.68	0.53	0.82	0.64	0.77	0.60	0.74	0.57
A-75	0.95	0.70	0.85	0.62	0.79	0.58	0.98	0.98	1.02	0.74	0.92	0.67	0.86	0.63	1.09	0.79	0.99	0.72	0.93	0.68
B-75	1.26	0.87	1.09	0.75	1.00	0.69	1.15	0.98	1.34	0.92	1.18	0.81	1.09	0.75	1.42	0.98	1.26	0.87	1.17	0.81
C-75	1.54	1.02	1.31	0.87	1.19	0.79	1.44	1.21	1.64	1.09	1.42	0.94	1.30	0.87	1.72	1.15	1.53	1.02	1.42	0.94
D-75	0.82	0.67	0.76	0.62	0.76	0.62	0.98	0.98	0.89	0.72	0.83	0.67	0.83	0.67	0.95	0.77	0.89	0.73	0.89	0.72
A-100	1.07	0.81	0.96	0.73	0.90	0.69	0.98	0.98	1.14	0.86	1.03	0.79	0.98	0.74	1.21	0.92	1.11	0.84	1.06	0.80
B-100	1.36	0.98	1.19	0.86	1.11	0.80	1.15	0.98	1.46	1.04	1.29	0.93	1.20	0.86	1.54	1.10	1.38	0.99	1.29	0.93
C-100	1.64	1.13	1.41	0.98	1.29	0.90	1.44	1.21	1.75	1.21	1.53	1.06	1.41	0.98	1.84	1.27	1.65	1.14	1.53	1.06
D-100	1.01	0.85	1.01	0.85	1.00	0.85	1.00	0.91	1.09	0.91	1.09	0.92	1.09	0.92	1.18	0.98	1.18	0.98	1.18	0.98
A-125	1.18	0.92	1.07	0.84	1.03	0.82	1.00	0.98	1.26	0.98	1.15	0.90	1.12	0.88	1.34	1.05	1.24	0.97	1.21	0.95
B-125	1.47	1.09	1.30	0.97	1.21	0.90	1.21	1.00	1.57	1.16	1.40	1.04	1.31	0.98	1.66	1.23	1.50	1.11	1.41	1.05
C-125	1.74	1.24	1.51	1.08	1.40	1.00	1.40	1.32	1.86	1.32	1.64	1.17	1.52	1.09	1.96	1.40	1.76	1.26	1.65	1.18
D-125																				

TABLE 1 Continued

Internal Designated Dia, in.		Circumferential reinforcement, in. ² /linear ft of pipe																					
		90		96		102		108		120		132		144									
Type of Reinforcement	Circular	8		8		8 1/2		8 1/2		9		9 1/2		10		11		12					
		Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer				
Wall Thickness, in.		7 1/2	8	8	8 1/2	8 1/2	9	9	9	9 1/2	9 1/2	10	10	11	11	12	12	12	12				
Layers of Reinforcement		Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner	Outer				
Class																							
A-25		0.62	0.41	0.59	0.39	0.67	0.45	0.64	0.43	0.72	0.48	0.69	0.46	0.77	0.51	0.75	0.49	0.89	0.58	1.01	0.66	1.14	0.74
B-25		0.90	0.57	0.85	0.54	0.96	0.61	0.91	0.58	1.02	0.65	0.97	0.62	1.08	0.69	1.04	0.66	1.22	0.77	1.36	0.86	1.52	0.96
C-25		1.25	0.77	1.16	0.72	1.31	0.81	1.23	0.76	1.39	0.86	1.31	0.81	1.46	0.90	1.38	0.85	1.62	1.00	1.78	1.10	1.96	1.21
D-25		1.59	0.97	1.50	0.91	1.69	1.03	1.61	0.97	1.79	1.09	1.69	1.02	1.88	1.15	1.77	1.07	S	S	S	S	S	S
A-50		0.75	0.55	0.72	0.53	0.81	0.59	0.78	0.57	0.87	0.63	0.84	0.61	0.93	0.67	0.90	0.65	1.06	0.76	1.19	0.85	1.34	0.94
B-50		1.03	0.71	0.98	0.67	1.09	0.75	1.04	0.71	1.16	0.80	1.11	0.76	1.23	0.84	1.18	0.81	1.38	0.94	1.54	1.04	1.71	1.15
C-50		1.37	0.90	1.29	0.85	1.44	0.95	1.36	0.90	1.52	1.00	1.45	0.95	1.60	1.05	1.53	1.00	1.77	1.16	1.95	1.28	2.14	1.40
D-50		1.71	1.10	1.62	1.03	1.82	1.16	1.73	1.10	1.93	1.23	1.82	1.16	2.02	1.29	1.91	1.22	S	S	S	S	S	S
A-75		0.89	0.69	0.86	0.66	0.95	0.73	0.92	0.71	1.02	0.78	0.99	0.76	1.08	0.83	1.06	0.81	1.23	0.93	1.38	1.03	1.54	1.14
B-75		1.16	0.84	1.11	0.80	1.23	0.89	1.18	0.85	1.31	0.94	1.26	0.91	1.38	1.00	1.34	0.96	1.55	1.11	1.72	1.23	1.90	1.35
C-75		1.49	1.03	1.41	0.97	1.58	1.09	1.50	1.03	1.66	1.14	1.58	1.09	1.75	1.20	1.67	1.15	1.93	1.33	2.12	1.46	2.33	1.59
D-75		1.83	1.22	1.74	1.16	1.95	1.30	1.86	1.24	2.06	1.37	1.96	1.30	2.16	1.44	2.06	1.37	S	S	S	S	S	S
A-100		1.02	0.82	0.99	0.80	1.09	0.88	1.06	0.85	1.17	0.93	1.14	0.91	1.24	0.99	1.21	0.96	1.40	1.10	1.56	1.22	1.74	1.35
B-100		1.29	0.97	1.24	0.94	1.37	1.03	1.32	1.00	1.45	1.09	1.40	1.06	1.54	1.15	1.49	1.12	1.71	1.28	1.90	1.41	2.09	1.55
C-100		1.62	1.16	1.54	1.10	1.71	1.22	1.63	1.17	1.80	1.29	1.72	1.24	1.90	1.36	1.82	1.30	2.09	1.49	2.30	1.64	2.51	1.79
D-100		1.96	1.35	1.86	1.29	2.08	1.43	1.99	1.37	2.20	1.52	2.09	1.45	2.30	1.59	2.20	1.52	S	S	S	S	S	S
A-125		1.27	1.05	1.26	1.05	1.35	1.12	1.35	1.12	1.44	1.18	1.44	1.18	1.53	1.25	1.53	1.25	1.70	1.38	1.88	1.52	2.06	1.65
B-125		1.42	1.11	1.37	1.07	1.51	1.17	1.46	1.14	1.60	1.24	1.55	1.20	1.69	1.31	1.64	1.27	1.88	1.45	2.08	1.60	2.29	1.75
C-125		1.75	1.29	1.67	1.24	1.84	1.36	1.77	1.31	1.94	1.44	1.87	1.38	2.04	1.51	1.97	1.46	2.25	1.66	2.47	1.82	2.70	1.98
D-125		2.08	1.48	1.99	1.41	2.21	1.57	2.27	1.50	2.34	1.66	2.23	1.59	2.45	1.74	2.35	1.67	S	S	S	S	S	S