



Designation: C506 – 22a

Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe¹

This standard is issued under the fixed designation C506; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

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

1. Scope*

1.1 This specification covers reinforced arch-shaped concrete pipe to be used for the conveyance of sewage, industrial wastes, storm water, and for the construction of culverts.

1.2 This specification is the inch-pound companion to C506M; therefore, no SI equivalents are presented in the specification. Reinforced concrete pipe that conform to the requirements of C506M are acceptable under this Specification C506 unless prohibited by the owner.

NOTE 1—This specification is a manufacturing and purchase specification only, and does not include requirements for bedding, backfill, or the relationship between field load condition and the strength classification of pipe. However, experience has shown that the successful performance of this product depends upon the proper selection of the class of pipe, type of bedding and backfill, and care that the installation conforms to the construction specifications. The owner of the reinforced concrete pipe specified herein is cautioned that he must correlate the field requirements with the class of pipe specified and provide inspection at the construction site.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

A36/A36M Specification for Carbon Structural Steel

A615/A615M Specification for Deformed and Plain Carbon-

Steel Bars for Concrete Reinforcement

A706/A706M Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

A1064/A1064M Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

C33/C33M Specification for Concrete Aggregates

C150/C150M Specification for Portland Cement

C260/C260M Specification for Air-Entraining Admixtures for Concrete

C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete

C494/C494M Specification for Chemical Admixtures for Concrete

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

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/C989M Specification for Slag Cement for Use in Concrete and Mortars

C990 Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete (Withdrawn 2022)³

C1116/C1116M Specification for Fiber-Reinforced Concrete

C1602/C1602M Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

C1896 Specification for Joints for Concrete Arch Pipe Using Profile Rubber Gaskets

¹ This specification is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.02 on Reinforced Sewer and Culvert 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. Terminology

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

³ The last approved version of this historical standard is referenced on www.astm.org.

*A Summary of Changes section appears at the end of this standard

4. Classification

4.1 Pipe manufactured according to this specification shall be of three classes identified as Class A-II, A-III, and A-IV. The strength requirements are prescribed in Table 1.

5. Basis of Acceptance

5.1 Unless otherwise designated by the owner at the time of, or before placing an order, there are two separate and alternative bases of acceptance. Independent of the method of acceptance, the pipe shall be designed to meet both the 0.01-in. crack and ultimate strength requirements.

5.1.1 *Acceptance on Basis of Plant Load Bearing Tests, Material Tests, and Inspection of Manufactured Pipe for Visual Defects and Imperfections*—Acceptability of the pipe in all diameters and classes produced in accordance with 7.1 or 7.2, shall be determined by the results of the three-edge-bearing tests as defined in 11.3.1; by such material tests as are required in accordance with 6.2, 6.3, 6.5, and 6.6, by an absorption test

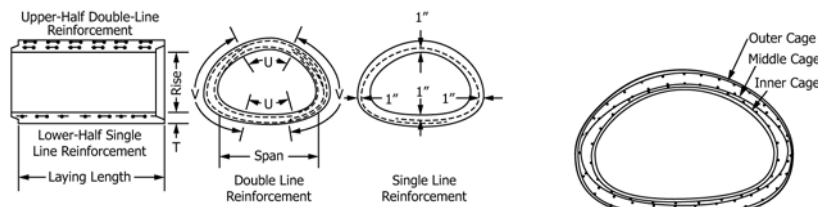
of the concrete from the wall of the pipe as required in 11.9; and by visual inspection of the finished pipe to determine its conformance with the accepted design and its freedom from defects.

5.1.2 *Acceptance on Basis of Material Tests and Inspection of Manufactured Pipe for Defects and Imperfections*—Acceptability of the pipe in all diameters and classes produced in accordance with 7.1 or 7.2 shall be determined by the results of such material tests as are required in 6.2, 6.3, 6.5, and 6.6; by crushing tests on concrete cores or cured concrete cylinders; by an absorption test of the concrete from the wall of the pipe for each mix design that is used on an order; and by inspection of the finished pipe, including amount and placement of reinforcement, to determine its conformance with the accepted design and its freedom from defects.

5.1.3 When agreed upon by the owner and the manufacturer, any portion or any combination of the tests itemized in 5.1.1 or 5.1.2 may form the basis of acceptance.

TABLE 1 Strength Requirements for Reinforced Concrete Pipe^A

Approximate Equivalent Round Size, in.	T, in.	Minimum Rise, in.	Minimum Span, in.	Double Line Reinforcement ^C																		Single Line Reinforcement			
				$f'c,^B$ ksi			Continuous Basic Reinforcement = A_s^D									Additional Reinforcement = A_s^D									
							Class			Inner Cage			Outer Cage			“U” (Inner Cage)			“V” (Outer Cage)						
				A-II	A-III	A-IV	A-II	A-III	A-IV	A-II	A-III	A-IV	Dimen- sion, in.	A-II	A-III	A-IV	Dimen- sion, in.	A-II	A-III	A-IV					
15	2¼	11	18	4	4	4	...	...	...	...	...	...	...	...	...	...	...	...	0.08	0.12	0.17				
18	2½	13½	22	4	4	4	...	...	...	...	...	...	...	...	...	...	...	...	0.11	0.14	0.26				
21	2¾	15½	26	4	4	4	...	...	...	...	...	...	...	...	...	...	...	...	0.12	0.17	0.29				
24	3	18	28½	4	4	4	...	...	...	...	...	...	...	...	...	...	...	...	0.16	0.21	0.32				
30	3½	22½	36¼	4	4	4	0.09	0.12	0.18	0.07	0.09	0.14	26	0.09	0.12	0.18	29	0.07	0.09	0.12	0.18	0.24	0.36		
36	4	26¾	43¾	4	4	4	0.11	0.15	0.21	0.09	0.12	0.17	30	0.11	0.15	0.21	34	0.09	0.12	0.16	0.21	0.30	0.44		
42	4½	31⅝	51⅝	4	4	4	0.12	0.18	0.27	0.10	0.14	0.21	34	0.12	0.18	0.27	39	0.10	0.14	0.21	0.26	0.36	0.54		
48	5	36	58½	4	4	...	0.15	0.21	...	0.12	0.17	...	42	0.15	0.21	...	43	0.12	0.17	...	0.30	0.44	...		
54	5½	40	65	4	4	...	0.18	0.24	...	0.14	0.19	...	48	0.18	0.24	...	49	0.14	0.19	...	0.36	0.48	...		
60	6	45	73	4	4	...	0.21	0.27	...	0.17	0.21	...	52	0.21	0.27	...	55	0.17	0.21	...	0.42	0.56	...		
72	7	54	88	4	5	...	0.26	0.36	...	0.20	0.27	...	60	0.26	0.36	...	67	0.20	0.27	...	0.52	0.72	...		
84	8	62	102	4	5	...	0.32	0.44	...	0.24	0.34	...	68	0.32	0.44	...	77	0.24	0.34	...	0.64	0.88	...		
90	8½	72	115	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...			
96	9	77½	122	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...			
108	10	87⅞	138	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...			
120	11	96⅞	154	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...			
132	10	106½	168¾	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...			



Typical Longitudinal Section

Sections

Triple Line Reinforcement

D-Loads for 3-Edge-Bearing Method

Class	0.01-in. Crack	Ultimate
II	1000	1500
III	1350	2000
IV	2000	3000

Note—Test load in pounds per linear foot equals D-load × inside span in feet.

^AFor modified or special designs, see 7.3.

^B $f'c$, ksi = minimum compressive strength of concrete in thousands of pounds-force per square inch.

^CAs an alternative to designs requiring double line reinforcement, the reinforcement may be positioned and proportioned so that the total reinforcement of the inner cage plus the middle cage shall not be less than that specified for the inner cage continuous basic reinforcement, and the additional reinforcement "U" and the total reinforcement of the outer cage plus the middle cage shall not be less than that specified for the outer cage continuous basic reinforcement and the additional reinforcement "V."

^D A_s = circumferential steel area in square inches per longitudinal foot of pipe barrel in each continuous basic cage and additional cages in area denoted "U" and "V." Dimensions "U" and "V" are measured on the center line of the culvert wall.