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

AASHTO Designation: M 206M/M 206-20¹

Technical Subcommittee: 4a, Concrete Drainage Structures

Release: Group 2 (June)

ASTM Designation: C506M-16b and C506-16b



**American Association of State Highway and Transportation Officials
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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 applicable for orders in either SI units (M 206M) or in inch-pound units (M 206). SI units and inch-pound units are not necessarily equivalent. Inch-pound units are shown in brackets in the text for clarity, but they are the applicable values when the material is ordered to M 206.

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 on the proper selection of the class of pipe, type of bedding and backfill, and care that the installation conforms to the construction specifications. Owners of the reinforced concrete pipe specified herein are cautioned that they must correlate the field requirements with the class of pipe specified and provide inspection at the construction site.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards:*

- M 6, Fine Aggregate for Hydraulic Cement Concrete
- M 31M/M 31, Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement
- M 80, Coarse Aggregate for Hydraulic Cement Concrete
- M 85, Portland Cement
- M 154M/M 154, Air-Entraining Admixtures for Concrete
- M 157, Ready-Mixed Concrete
- M 194M/M 194, Chemical Admixtures for Concrete
- M 240M/M 240, Blended Hydraulic Cement
- M 262, Concrete Pipe and Related Products
- M 295, Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- M 302, Slag Cement for Use in Concrete and Mortars

- M 336M/M 336, Steel Wire and Welded Wire, Plain and Deformed, for Concrete Reinforcement
- T 280, Concrete Pipe, Manhole Sections, or Tile

2.2. *ASTM Standards:*

- A36/A36M, Standard Specification for Carbon Structural Steel
- A706/A706M, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
- C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
- C1116/C1116M, Standard Specification for Fiber-Reinforced Concrete

3. TERMINOLOGY

- 3.1. *Definitions*—For definitions of terms relating to concrete pipe, see M 262.

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 for SI units or Table 2 for inch-pound units.

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 0.3-mm [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 Section 7.1 or Section 7.2 shall be determined by the results of the three-edge-bearing tests as defined in Section 11.3.1; by such material tests as are required in accordance with Sections 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 the Complete Product*—Acceptability of the pipe in all diameters and classes produced in accordance with Section 7.1 or 7.2 shall be determined by the results of such material tests as are required in Sections 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 tests itemized in Section 5.1.1 or Section 5.1.2 may form the basis of acceptance.
- 5.2. *Age for Acceptance*—Pipes shall be considered ready for acceptance when they conform to the requirements as indicated by the specified tests.

Table 1—Strength Requirements for Reinforced Concrete Pipe (SI units)^a

Double Line Reinforcement ^c																											
Approx. Equiv. Round Size, mm				f'_c MPa ^b			Continuous Basic Reinforcement = A_s^d																		Single Line Reinforcement		
							Additional Requirement = A_s^d																				
				Class			Inner Cage			Outer Cage			“U” (Inner Cage)			“V” (Outer Cage)											
Di-men-sion, mm	A-II	A-III	A-IV										Di-men-sion, mm	A-II	A-III	A-IV											
	T , mm	Min. Rise, mm	Min. Span, mm	A-II	A-III	A-IV	A-II	A-III	A-IV	A-II	A-III	A-IV	Di-men-sion, mm	A-II	A-III	A-IV	Di-men-sion, mm	A-II	A-III	A-IV	A-II	A-III	A-IV				
375	57	280	460	27.6	27.6	27.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.7	2.5	3.6				
450	63	345	560	27.6	27.6	27.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.3	3.0	5.5				
525	69	395	660	27.6	27.6	27.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.8	3.6	6.1				
600	75	460	725	27.6	27.6	27.6	—	—	—	—	—	—	660	—	—	—	735	—	—	—	3.4	4.6	6.8				
750	88	570	920	27.6	27.6	27.6	1.9	2.5	3.8	1.5	1.9	3.0	760	1.9	2.5	3.8	865	1.5	1.9	2.8	3.8	5.1	7.6				
900	100	675	1110	27.6	27.6	27.6	2.3	3.2	4.6	1.9	2.5	3.6	865	2.3	3.2	4.6	990	1.9	2.5	3.4	4.6	6.3	9.3				
1050	113	795	1300	27.6	27.6	27.6	2.8	3.8	5.7	2.1	3.0	4.4	1065	2.8	3.8	5.7	1090	2.1	3.0	4.6	5.5	7.6	11.4				
1200	125	915	1485	27.6	27.6	—	3.2	4.6	—	2.5	3.6	—	1220	3.2	4.6	—	1245	2.5	3.6	—	6.3	9.3	—				
1350	138	1015	1650	27.6	27.6	—	3.8	5.1	—	3.0	4.0	—	1320	3.8	5.1	—	1395	3.0	4.0	—	7.6	10.2	—				
1500	150	1145	1855	27.6	27.6	—	4.4	5.9	—	3.6	4.6	—	1525	4.4	5.9	—	1700	3.6	4.6	—	8.9	11.8	—				
1800	175	1370	2235	27.6	34.5	—	5.5	7.6	—	4.2	5.9	—	1725	5.5	7.6	—	1955	4.2	5.9	—	11.0	15.2	—				
2100	200	1575	2590	27.6	34.5	—	6.8	9.3	—	5.1	7.2	—	—	6.8	9.3	—	—	5.1	7.2	—	13.5	18.6	—				
2250	213	1830	2920	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
2400	225	1960	3100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
2700	250	2215	3505	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
3000	275	2460	3910	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
3300	250	2705	4285	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				

^a For modified or special designs, see Section 7.3.^b f'_c MPa = minimum compressive strength of concrete in megapascals.^c As an alternative to designs requiring double line reinforcement, the reinforcement may be positioned and proportional 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 millimeters per longitudinal centimeter 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 centerline of the culvert wall.

D-Loads for Three-Edge-Bearing Method		
Class	0.3-mm Crack	Ultimate
A-II	50.0	75.0
A-III	65.0	100.0
A-IV	100.0	150.0

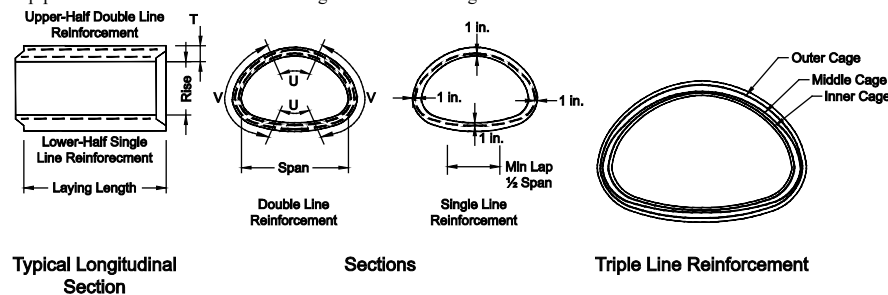
Note: Test load in newtons per linear meter equals
D-load × inside span in millimeters.

Table 2—Strength Requirements for Reinforced Concrete Pipe (inch-pound units)^a

Approx. Equiv. Round Size, in.				Double Line Reinforcement ^c																				Single Line Reinforcement		
				f'_c ksi ^b			Continuous Basic Reinforcement = A_s^d														Additional Requirement = A_s^d					
							Inner Cage			Outer Cage			“U” (Inner Cage)			“V” (Outer Cage)										
																			Class							
T , in.	Min. Rise, in.	Min Span, in.	A-II	A-III	A-IV	A-II	A-III	A-IV	A-II	A-III	A-IV	Di-men-sion, in.	A-II	A-III	A-IV	Di-men-sion, in.	A-II	A-III	A-IV	A-II	A-III	A-IV				
15	2 ¹ / ₄	11	18	4	4	4	—	—	—	—	—	—	—	—	—	—	—	—	—	0.08	0.12	0.17				
18	2 ¹ / ₂	13 ¹ / ₂	22	4	4	4	—	—	—	—	—	—	—	—	—	—	—	—	—	0.11	0.14	0.26				
21	2 ³ / ₈	15 ¹ / ₂	26	4	4	4	—	—	—	—	—	—	—	—	—	—	—	—	—	0.13	0.17	0.29				
24	3	18	28 ¹ / ₂	4	4	4	—	—	—	—	—	—	—	—	—	—	—	—	—	0.16	0.21	0.32				
30	3 ¹ / ₂	22 ¹ / ₂	36 ¹ / ₄	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	0.13	0.18	0.24	0.36			
36	4	26 ⁵ / ₈	43 ³ / ₈	4	4	4	0.11	0.15	0.22	0.09	0.12	0.17	30	0.11	0.15	0.22	34	0.09	0.12	0.16	0.21	0.30	0.44			
42	4 ¹ / ₂	31 ⁵ / ₁₆	51 ¹ / ₈	4	4	4	0.13	0.18	0.27	0.10	0.14	0.21	34	0.13	0.18	0.27	39	0.10	0.14	0.22	0.26	0.36	0.54			
48	5	36	58 ¹ / ₂	4	4	—	0.15	0.22	—	0.12	0.17	—	42	0.15	0.21	—	43	0.12	0.17	—	0.30	0.44	—			
54	5 ¹ / ₂	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	0.28	—	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	8 ¹ / ₂	72	115	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
96	9	77 ¹ / ₂	122	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
108	10	87 ¹ / ₈	138	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
120	11	96 ⁷ / ₈	154	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
132	10	106 ¹ / ₂	168 ³ / ₄	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—				

^a For modified or special designs, see Section 7.3.

^b f'_c ksi = minimum compressive strength of concrete in thousands of pounds-force per square inch.

^c As an alternative to designs requiring double line reinforcement, the reinforcement may be positioned and proportional 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 centerline of the culvert wall.

D-Loads for Three-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.

