TF 306-R-10

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WELDED WIRE REINFORCEMENT FOR CIRCULAR CONCRETE PIPE

Concrete pipe producers everywhere have long relied on welded wire reinforcement (WWR) in the manufacture of their products. Government agencies and private developers have come to rely on the structural integrity and performance of these products to provide a safe and healthy living environment. The producers of WWR continue to play an importantrole in the ever expanding proven track record of reinforced concrete pipe by supplying quality materials in the most efficient configurations.

This document is intended to provide sound recommendations for use in estimating the reinforcing steel in a concrete pipe. The information on the following pages was compiled using the published reinforcing designs of the American Society for Testing and Materials *"Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe," Designation C 76*

WWR for the reinforced concrete pipe (RCP) industry is produced in accordance with ASTM A 1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.The RCP industry uses a unique nomenclature when describing WWR that is different from most other reinforced products. The wires providing the structural integrity to the pipe run circumferentially within the pipe wall. *These wires are referred to as circumferential wires.* The wires which run from spigot to bell, or tongue to groove, are called *cross wires.*

Although C 76 does not require any longitudinal reinforcement in the pipe, cross wires are present primarily for three reasons. First, the cross wires provide assurance that the circumferential wires remain at the correct spacing during cage fabrication and pipe casting. Second, the cross wires provide support for the freshly cast pipe while it cures. Third, a minimum cross wire area equal to 40% of the circumferential wire area is required by ASTM specifications A 1064 to ensure strong welds.

The tables on the following pages list only the most common styles used throughout the RCP industry today. They are also some of the most efficient. Here are the conventions that were used to develop these tables:

- The minimum cross wire size is W2.5.
- Cross wire spacing in single cage pipe is 6 inches, and in double cage pipe is 8 inches.
- Maximum circumferential wire size is W12.
- Wire size increments are by half W-number.
- Only B-wall and C-wall, Class II through Class V designs are shown.
- Weights were calculated using a style width of 93" (+1,+1) for 3" spaced styles, and a width of 94" (+1,+0) for 2" spaced styles for pipe with a laying length of 8'-0".
- Expandable bell reinforcing cages were excluded.
- Cage lengths were calculated to provide 1" clear cover, a minimum 2" welded lap, then rounded to the next higher cross wire space.
- Elliptical cage configurations are not shown.
- Elliptical areas are shown for reference only.

Wire sizes are based on nominal diameters and/or weights per LF. Tolerances per ASTM A 1064 apply. The user of this document is responsible for making any adjustments necessary to meet specific conditions, should they differ from these conventions. Wire size increments of 0.1 W-number and sizes larger than W12 are available upon request. C 76 provides the RCP producer with several provisions regarding reinforcing cage configuration. The tables on the following pages take advantage of all these provisions to arrive at the most efficient cage configuration possible with the conventions listed. One such provision is found in C 76 Table 4, footnote B, which states that C-wall 24-in. to 33-in. diameter pipe may utilize a single cage having an area not less than the sum of the inner and outer specified areas. This provision creates efficiencies over the standard two-cage design simply because there is one less cage to fabricate.

A similar provision is found in two places in C 76. Tables 2 and 3, footnote E permits the use of a single reinforcing cage for 36-in. diameter B-wall and C-wall pipe, but calls out specific areas to be met.

Another provision is found in all the tables under footnote B which permits the use of quadrant mats. This may very well be the single most economical configuration available in the C 76 specification. This provision is used primarily where steel areas above 0.60 $in.^2$ per linear foot are required. When applied to both the inner and outer cages, steel savings can range from 20% to 37%. Figures 1 and 2 illustrate the concept of quadrant mat reinforcing. Very

simply, this provision allows the producer to concentrate the placement of the steel to the regions or "quadrants" of the pipe wall where it is needed. When a concrete pipe is loaded, tension develops in the crown and invert on the inside face of the pipe wall, and at the springline on the outside face of the pipe wall. The quadrant mats are placed in these areas to resist the tensile forces that develop. Opposite these locations the pipe wall is in compression, which the concrete alone can resist. The typical quadrant mat configuration consists of a full circular cage having an area of at least 25% of the specified area for that cage, with the remaining area provided by each of two 90° quadrant mats placed as shown in Figure 1. The combined areas of the full circular cage and either single quadrant mat must be equal to or greater than the area specified for that cage.

A more practical quadrant mat configuration is the use of a "quadrant cage" and a single quadrant mat (Figure 2). The quadrant cage is rolled $1^1/_4$ turns (450°) and overlapped by 90 to include the first "quadrant mat". Then a single 90° quadrant mat is rolled and placed opposite the 90° overlap. The quadrant cage and quadrant mat are rolled from the same style which is at least 50% of the specified cage area. Where the overlap occurs and where the quadrant mat is placed, the total area is equal to or greater than the specified cage area. When this configuration is used, labor is minimized and a steel savings of up to 25% is realized. This quadrant cage (QC) and quadrant mat (QM) configuration is used throughout the following tables where specified areas exceed 0.60 in.^{2} per linear foot of pipe wall.

Probably the least understood provision in C76 is found under Permissible Variations Section 12.5.2 – *Area of Reinforcement.* It uses the alternate elliptical cage area listed in the table for a given pipe diameter and class to calculate the permissible variations of the inner and outer cages. It states that when inner and outer circular cages are used, the area of the inner cage must be at least 85% of the specified alternate elliptical cage area and the area of the outer cage must be at least 51% of the elliptical area, but the total area of the inner and outer cages must be at least 140% of the elliptical area. This allows for small adjustments in the inner and outer cage areas that can result in savings of nearly 10% (see page 10 – 66" Class III C-wall design). The designs created using Permissible Variations Section 12.5.2 are identified by a u in the following tables.

The format of the tables on the following pages has been revised from previous printings of this *Tech Fact.* The left third of each table lists the design requirements of ASTM C 76-97, including diameter, class, 0.01-inch crack and ultimate D-Loads, wall designation and thickness, and concrete strength. The center third lists the inner cage data, including minimum area required, wire spacing, wire size, cage length, and cage weight per linear foot of pipe. The right third lists the corresponding outer cage data, and along the far right side of each table is the total cage weight per linear foot of pipe and the specified alternate elliptical cage area used in Section 12.5.2 calculations.

The purpose of this document is to provide guidance and suggestions for reinforcing configurations that meet the minimum reinforcing requirements of the ASTM C 76-97 Specification. Naturally there are many other configurations available to the concrete pipe producer for their use. These are simply the most common being used in today's market.

Contact a WRI member producer for specific requests and conditions that are not addressed in this document. Styles and wire sizes other than those shown in the tables are available upon request. This Tech Fact was prepared under the direction of the Pipe Reinforcement Committee of the Wire Reinforcement Institute, Inc.

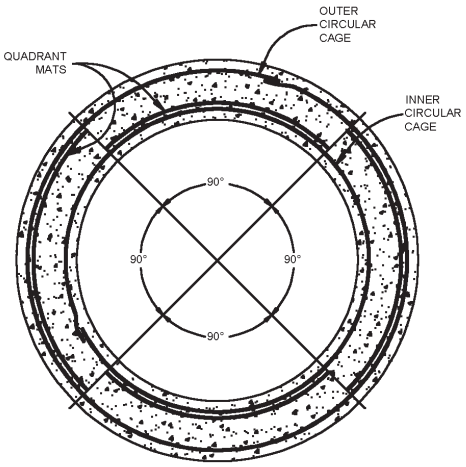

FIGURE 1

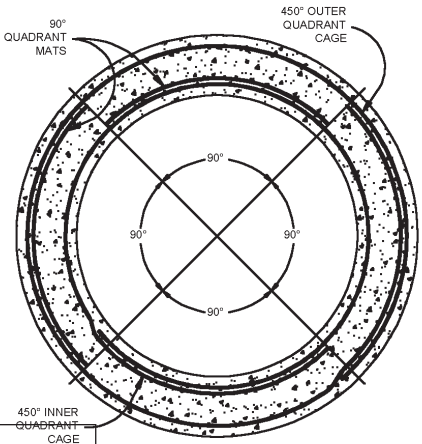

FIGURE 2

Key

QC	-	450° Quadrant Cage
QM	-	90° Quadrant Mat
FC	-	360° Full Circular Cage

Note: In the following tables, where quadrant designs appear below an alternate design identified by a ◆, the quadrant design represents the alternate design.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT											
							INNER CAGE					OUTER CAGE					Total Cage Weight	Alternate Elliptical Area
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight		
in.	-	lbs./ft./ft.	lbs./ft./ft.	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
12"	IV	2,000	3,000	B	2"	4,000	0.07	3 x 6	2.0 x 2.5	4'-0"	1.76	-	-	-	-	-	1.76	-
				C	2 3/4"	4,000	0.07	3 x 6	2.0 x 2.5	4'-0"	1.76	-	-	-	-	-	1.76	-
12"	V	3,000	3,750	B	2"	6,000	0.10	3 x 6	2.5 x 2.5	4'-0"	2.03	-	-	-	-	-	2.03	-
				C	2 3/4"	6,000	0.07	3 x 6	2.0 x 2.5	4'-0"	1.76	-	-	-	-	-	1.76	-
15"	III	1,350	2,000	B	2 1/4"	4,000	0.07	3 x 6	2.0 x 2.5	5'-0"	2.20	-	-	-	-	-	2.20	-
				C	3"	4,000	0.07	3 x 6	2.0 x 2.5	5'-0"	2.20	-	-	-	-	-	2.20	-
15"	IV	2,000	3,000	B	2 1/4"	4,000	0.10	3 x 6	2.5 x 2.5	5'-0"	2.54	-	-	-	-	-	2.54	-
				C	3"	4,000	0.07	3 x 6	2.0 x 2.5	5'-0"	2.20	-	-	-	-	-	2.20	-
15"	V	3,000	3,750	B	2 1/4"	6,000	0.14	3 x 6	3.5 x 2.5	5'-0"	3.22	-	-	-	-	-	3.22	-
				C	3"	6,000	0.07	3 x 6	2.0 x 2.5	5'-0"	2.20	-	-	-	-	-	2.20	-
18"	III	1,350	2,000	B	2 1/2"	4,000	0.07	3 x 6	2.0 x 2.5	5'-6"	2.42	-	-	-	-	-	2.42	0.07
				C	3 1/4"	4,000	0.07	3 x 6	2.0 x 2.5	5'-6"	2.42	-	-	-	-	-	2.42	0.07
18"	IV	2,000	3,000	B	2 1/2"	4,000	0.14	3 x 6	3.5 x 2.5	5'-6"	3.54	-	-	-	-	-	3.54	0.11
				C	3 1/4"	4,000	0.07	3 x 6	2.0 x 2.5	5'-6"	2.42	-	-	-	-	-	2.42	0.07
18"	V	3,000	3,750	B	2 1/2"	6,000	0.19	3 x 6	5.0 x 3.0	5'-6"	4.85	-	-	-	-	-	4.85	0.16
				C	3 1/4"	6,000	0.10	3 x 6	2.5 x 2.5	5'-6"	2.79	-	-	-	-	-	2.79	-

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT										Alternate Elliptical Area
							INNER CAGE					OUTER CAGE					Total Cage Weight
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	
in.	-	lbs./ft./ft.	lbs./ft./ft.	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
21"	III	1,350	2,000	B	2 3/4"	4,000	0.07	3 x 6	2.0 x 2.5	6'-6"	2.86	-	-	-	-	-	2.86	0.07
				C	3 1/2"	4,000	0.07	3 x 6	2.0 x 2.5	6'-6"	2.86	-	-	-	-	-	2.86	0.07
21"	IV	2,000	3,000	B	2 3/4"	4,000	0.20	3 x 6	5.0 x 3.0	6'-6"	5.73	-	-	-	-	-	5.73	0.17
				C	3 1/2"	4,000	0.07	3 x 6	2.0 x 2.5	6'-6"	2.86	-	-	-	-	-	2.86	0.07
21"	V	3,000	3,750	B	2 3/4"	6,000	0.24	2 x 6	4.0 x 2.5	6'-6"	6.40	-	-	-	-	-	6.40	0.21
				C	3 1/2"	6,000	0.10	3 x 6	2.5 x 2.5	6'-6"	3.30	-	-	-	-	-	3.30	-
24"	III	1,350	2,000	B	3"	4,000	0.07	3 x 6	2.0 x 2.5	7'-6"	3.30	-	-	-	-	-	3.30	0.07
				C	3 3/4"	4,000	0.07	3 x 6	2.0 x 2.5	7'-6"	3.30	-	-	-	-	-	3.30	0.07
24"	IV	2,000	3,000	B	3"	4,000	0.27	2 x 6	4.5 x 2.5	7'-6"	8.15	-	-	-	-	-	8.15	0.23
				C	3 3/4"	4,000	0.07	3 x 8	2.0 x 2.5	7'-4"	2.92	0.07	3 x 8	2.0 x 2.5	8'-0"	3.19	6.11	0.08
				C	3 3/4"	4,000	0.14	3 x 6	3.5 x 2.5	7'-6"	4.83	-	-	-	-	-	4.83	-
24"	V	3,000	3,750	B	3"	6,000	0.30	2 x 6	5.0 x 3.0	7'-6"	9.16	-	-	-	-	-	9.16	0.24
				C	3 3/4"	6,000	0.12	3 x 8	3.0 x 2.5	7'-4"	3.92	0.07	3 x 8	2.0 x 2.5	8'-0"	3.19	7.11	0.13
27"	II	1,000	1,500	B	3 1/4"	4,000	0.13	2 x 6	2.5 x 2.5	8'-0"	5.43	-	-	-	-	-	5.43	0.11
				C	4"	4,000	0.07	3 x 6	2.0 x 2.5	8'-0"	3.52	-	-	-	-	-	3.52	0.07
27"	III	1,350	2,000	B	3 1/4"	4,000	0.16	3 x 6	4.0 x 2.5	8'-0"	5.70	-	-	-	-	-	5.70	0.14
				C	4"	4,000	0.08	3 x 6	2.0 x 2.5	8'-0"	3.52	-	-	-	-	-	3.52	0.07

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT										
							INNER CAGE					OUTER CAGE					
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Total Cage Weight	Alternate Elliptical Area
in.	-	**lbs./ft./ft.**	**lbs./ft./ft.**	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
27"	IV	2,000	3,000	B	3 1/4"	4,000	0.31	2 x 6	5.5 x 3.0	8'-0"	10.59	-	-	-	-	-	10.59	0.25
				C	4"	4,000	0.08	3 x 8	2.0 x 2.5	8'-0"	3.19	0.07	3 x 8	2.0 x 2.5	9'-4"	3.72	6.91	0.09
				C	4"	4,000	0.15	2 x 6	2.5 x 2.5	8'-0"	5.43	-	-	-	-	-	5.43	-
								3 x 6	4.0 x 2.5	8'-0"	5.70	-	-	-	-	-	5.70	-
27"	V	3,000	3,750	B	3 1/4"	6,000	0.38	2 x 8	6.5 x 3.0	8'-0"	11.82	0.23	2 x 8	4.0 x 2.5	8'-8"	8.16	19.98	0.42
							◆ 0.36	2 x 8	6.0 x 3.0	8'-0"	11.00	◆ 0.24	2 x 8	4.0 x 2.5	8'-8"	8.16	19.16	
				C	4"	6,000	0.14	3 x 8	3.5 x 2.5	8'-0"	4.82	0.08	3 x 8	2.0 x 2.5	9'-4"	3.72	8.54	0.16
30"	II	1,000	1,500	B	3 1/2"	4,000	0.14	3 x 6	3.5 x 2.5	9'-0"	5.80	-	-	-	-	-	5.80	0.12
				C	4 1/4"	4,000	0.07	3 x 6	2.0 x 2.5	9'-0"	3.96	-	-	-	-	-	3.96	0.07
30"	III	1,350	2,000	B	3 1/2"	4,000	0.18	3 x 6	4.5 x 2.5	9'-0"	7.02	-	-	-	-	-	7.02	0.15
				C	4 1/4"	4,000	0.10	3 x 6	2.5 x 2.5	9'-0"	4.57	-	-	-	-	-	4.57	0.08
30"	IV	2,000	3,000	B	3 1/2"	4,000	0.35	2 x 6	6.0 x 3.0	9'-0"	12.83	-	-	-	-	-	12.83	0.28
				C	4 1/4"	4,000	0.09	3 x 8	2.5 x 2.5	8'-8"	4.04	0.07	3 x 8	2.0 x 2.5	10'-0"	3.98	8.02	0.10
				C	4 1/4"	4,000	0.16	3 x 6	4.0 x 2.5	9'-0"	6.41	-	-	-	-	-	6.41	-
30"	V	3,000	3,750	B	3 1/2"	6,000	0.41	2 x 8	7.0 x 3.0	8'-8"	13.69	0.25	2 x 8	4.5 x 2.5	9'-4"	9.74	23.43	0.46
							◆ 0.42	2 x 8	7.0 x 3.0	8'-8"	13.69	◆ 0.24	2 x 8	4.0 x 2.5	9'-4"	8.79	22.48	-
				C	4 1/4"	6,000	0.18	3 x 8	4.5 x 2.5	8'-8"	6.40	0.11	3 x 8	3.0 x 2.5	10'-0"	5.34	11.74	0.20
							◆ 0.18	3 x 8	4.5 x 2.5	8'-8"	6.40	◆ 0.10	3 x 8	2.5 x 2.5	10'-0"	4.66	11.06	-
33"	II	1,000	1,500	B	3 3/4"	4,000	0.15	2 x 6	2.5 x 2.5	9'-6"	6.44	-	-	-	-	-	6.44	0.13
								3 x 6	4.0 x 2.5	9'-6"	6.77	-	-	-	-	-	6.77	

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT											
							INNER CAGE					OUTER CAGE					Total Cage Weight	Alternate Elliptical Area
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight		
in.	-	**lbs./ft./ft.**	**lbs./ft./ft.**	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
33"	II	1,000	1,500	C	4 1/2"	4,000	0.07	3 x 6	2.0 x 2.5	9'-6"	4.18	-	-	-	-	-	4.18	0.07
33"	III	1,350	2,000	B	3 3/4"	4,000	0.20	3 x 6	5.0 x 3.0	9'-6"	8.38	-	-	-	-	-	8.38	0.17
				C	4 1/2"	4,000	0.12	3 x 6	3.0 x 2.5	9'-6"	5.47	-	-	-	-	-	5.47	0.10
33"	IV	2,000	3,000	B	3 3/4"	4,000	0.27	2 x 8	4.5 x 2.5	10'-0"	10.44	0.16	3 x 8	4.0 x 2.5	10'-8"	7.15	17.59	0.30
				C	4 1/2"	4,000	0.11	3 x 8	3.0 x 2.5	10'-0"	5.34	0.07	3 x 8	2.0 x 2.5	10'-8"	4.25	9.59	0.12
				C	4 1/2"	4,000	0.18	3 x 6	4.5 x 2.5	9'-6"	7.41	-	-	-	-	-	7.41	-
33"	V	3,000	3,750	B	3 3/4"	6,000	0.46	2 x 8	8.0 x 3.5	10'-0"	18.08	0.28	2 x 8	5.0 x 3.0	10'-8"	12.49	30.57	0.51
							◆ 0.45	2 x 8	7.5 x 3.0	10'-0"	16.81	◆ 0.27	2 x 8	4.5 x 2.5	10'-8"	11.14	27.95	-
				C	4 1/2"	6,000	0.23	2 x 8	4.0 x 2.5	10'-0"	9.42	0.14	3 x 8	3.5 x 2.5	10'-8"	6.42	15.84	0.25
							◆ 0.22	3 x 8	5.5 x 3.0	10'-0"	8.99	◆ 0.14	3 x 8	3.5 x 2.5	10'-8"	6.42	15.41	-
36"	II	1,000	1,500	B	4"	4,000	0.12	3 x 8	3.0 x 2.5	10'-8"	5.70	0.07	3 x 8	2.0 x 2.5	11'-4"	4.51	10.21	0.13
				B	4"	4,000	0.20	3 x 6	5.0 x 3.0	10'-6"	9.26	-	-	-	-	-	9.26	-
				C	4 3/4"	4,000	0.07	3 x 8	2.0 x 2.5	10'-8"	4.25	0.07	3 x 8	2.0 x 2.5	11'-4"	4.51	8.76	0.08
				C	4 3/4"	4,000	0.16	3 x 6	4.0 x 2.5	10'-6"	7.48	-	-	-	-	-	7.48	-
36"	III	1,350	2,000	B	4"	4,000	0.17	3 x 8	4.5 x 2.5	10'-8"	7.87	0.10	3 x 8	2.5 x 2.5	11'-4"	5.28	13.15	0.19
				B	4"	4,000	0.30	2 x 6	5.0 x 3.0	10'-6"	12.83	-	-	-	-	-	12.83	-
				C	4 3/4"	4,000	0.08	3 x 8	2.0 x 2.5	10'-8"	4.25	0.07	3 x 8	2.0 x 2.5	12'-0"	4.78	9.03	0.09
				C	4 3/4"	4,000	0.20	3 x 6	5.0 x 3.0	10'-6"	9.26	-	-	-	-	-	9.26	-

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT											Alternate Elliptical Area
							INNER CAGE					OUTER CAGE					Total Cage Weight	
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight		
in.	-	**lbs./ft./ft.**	**lbs./ft./ft.**	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
36"	IV	2,000	3,000	B	4"	4,000	0.30	2 x 8	5.0 x 3.0	10'-8"	12.49	0.18	3 x 8	4.5 x 2.5	11'-4"	8.36	20.85	0.33
				C	4 3/4"	4,000	0.14	3 x 8	3.5 x 2.5	10'-8"	6.42	0.08	3 x 8	2.0 x 2.5	12'-0"	4.78	11.20	0.15
36"	V	3,000	3,750	B	4"	6,000	0.50	2 x 8	8.5 x 3.5	10'-8"	20.38	0.30	2 x 8	5.0 x 3.0	11'-4"	13.27	33.65	0.56
				C	4 3/4"	6,000	0.27	2 x 8	4.5 x 2.5	10'-8"	11.14	0.16	3 x 8	4.0 x 2.5	12'-0"	8.04	19.18	0.30
42"	II	1,000	1,500	B	4 1/2"	4,000	0.15	2 x 8	2.5 x 2.5	12'-0"	7.63	0.09	3 x 8	2.5 x 2.5	13'-4"	6.21	13.84	0.17
								3 x 8	4.0 x 2.5	12'-0"	8.04						14.25	
				C	5 1/4"	4,000	0.10	3 x 8	2.5 x 2.5	12'-0"	5.59	0.07	3 x 8	2.0 x 2.5	14'-0"	5.57	11.16	0.11
42"	III	1,350	2,000	B	4 1/2"	4,000	0.21	2 x 8	3.5 x 2.5	12'-0"	10.08	0.13	3 x 8	3.5 x 2.5	13'-4"	8.03	18.11	0.23
								3 x 8	5.5 x 3.0	12'-0"	10.79						18.82	
							◆ 0.20	3 x 8	5.0 x 3.0	12'-0"	9.98	◆ 0.12	3 x 8	3.0 x 2.5	13'-4"	7.12	17.10	-
				C	5 1/4"	4,000	0.12	3 x 8	3.0 x 2.5	12'-0"	6.41	0.07	3 x 8	2.0 x 2.5	14'-0"	5.57	11.98	0.13
42"	IV	2,000	3,000	B	4 1/2"	4,000	0.35	2 x 8	6.0 x 3.0	12'-0"	16.50	0.21	2 x 8	3.5 x 2.5	13'-4"	11.20	27.70	0.39
													3 x 8	5.5 x 3.0	13'-4"	11.99	28.49	
							◆ 0.36	2 x 8	6.0 x 3.0	12'-0"	16.50	◆ 0.20	3 x 8	5.0 x 3.0	13'-4"	11.08	27.58	-
42"	IV	2,000	3,000	C	5 1/4"	4,000	0.20	3 x 8	5.0 x 3.0	12'-0"	9.98	0.12	3 x 8	3.0 x 2.5	14'-0"	7.48	17.46	0.22
42"	V	3,000	3,750	B	4 1/2"	6,000	0.60	2 x 8	10.0 x 4.0	12'-0"	26.90	0.36	2 x 8	6.0 x 3.0	13'-4"	18.34	45.24	0.67
				C	5 1/4"	6,000	0.36	2 x 8	6.0 x 3.0	12'-0"	16.50	0.22	3 x 8	5.5 x 3.0	14'-0"	12.59	29.09	0.40
48"	II	1,000	1,500	B	5"	4,000	0.18	3 x 8	4.5 x 2.5	13'-4"	9.84	0.11	3 x 8	3.0 x 2.5	15'-4"	8.19	18.03	0.20
							◆ 0.18	3 x 8	4.5 x 2.5	13'-4"	9.84	◆ 0.10	3 x 8	2.5 x 2.5	15'-4"	7.15	16.99	-
				C	5 3/4"	4,000	0.14	3 x 8	3.5 x 2.5	13'-4"	8.03	0.08	3 x 8	2.0 x 2.5	15'-4"	6.10	14.13	0.15

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT											Alternate Elliptical Area
							INNER CAGE					OUTER CAGE					Total Cage Weight	
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight		
in.	-	**lbs./ft./ft.**	**lbs./ft./ft.**	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
48"	III	1,350	2,000	B	5"	4,000	0.24	2 x 8	4.0 x 2.5	13'-4"	12.56	0.14	3 x 8	3.5 x 2.5	15'-4"	9.23	21.79	0.27
				C	5 3/4"	4,000	0.16	3 x 8	4.0 x 2.5	13'-4"	8.93	0.10	3 x 8	2.5 x 2.5	15'-4"	7.15	16.08	0.18
48"	IV	2,000	3,000	B	5"	4,000	0.42	2 x 8	7.0 x 3.0	13'-4"	21.06	0.25	2 x 8	4.5 x 2.5	15'-4"	16.01	37.07	0.47
							◆ 0.42	2 x 8	7.0 x 3.0	13'-4"	21.06	◆ 0.24	2 x 8	4.0 x 2.5	15'-4"	14.44	35.50	-
				C	5 3/4"	4,000	0.26	2 x 8	4.5 x 2.5	13'-4"	13.92	0.16	3 x 8	4.0 x 2.5	15'-4"	10.27	24.19	0.29
48"	V	3,000	3,750	B	5"	6,000	0.73	2 x 8	12.5 x 5.0	13'-4"	37.36	0.44	2 x 8	7.5 x 3.0	15'-4"	25.78	63.14	0.81
							◆ 0.72	2 x 8	12.0 x 5.0	13'-4"	36.00	◆ 0.42	2 x 8	7.0 x 3.0	15'-4"	24.21	60.21	-
				C	5 3/4"	6,000	0.47	2 x 8	8.0 x 3.5	13'-4"	24.11	0.28	2 x 8	5.0 x 3.0	15'-4"	17.96	42.07	0.52
							◆ 0.48	2 x 8	8.0 x 3.5	13'-4"	24.11	◆ 0.27	2 x 8	4.5 x 2.5	15'-4"	16.01	40.12	-
54"	II	1,000	1,500	B	5 1/2"	4,000	0.22	3 x 8	5.5 x 3.0	15'-4"	13.79	0.13	3 x 8	3.5 x 2.5	16'-8"	10.04	23.83	0.24
							◆ 0.22	3 x 8	5.5 x 3.0	15'-4"	13.79	◆ 0.12	3 x 8	3.0 x 2.5	16'-8"	8.90	22.69	-
				C	6 1/4"	4,000	0.17	3 x 8	4.5 x 2.5	15'-4"	11.32	0.10	3 x 8	2.5 x 2.5	17'-4"	8.08	19.40	0.19
54"	III	1,350	2,000	B	5 1/2"	4,000	0.29	2 x 8	5.0 x 3.0	15'-4"	17.96	0.17	3 x 8	4.5 x 2.5	16'-8"	12.30	30.26	0.32
							◆ 0.30	2 x 8	5.0 x 3.0	15'-4"	17.96	◆ 0.16	3 x 8	4.0 x 2.5	16'-8"	11.17	29.13	-
				C	6 1/4"	4,000	0.21	2 x 8	3.5 x 2.5	15'-4"	12.88	0.13	3 x 8	3.5 x 2.5	17'-4"	10.44	23.32	0.23
								3 x 8	5.5 x 3.0	15'-4"	13.79						24.23	
							◆ 0.20	3 x 8	5.0 x 3.0	15'-4"	12.75	◆ 0.12	3 x 8	3.0 x 2.5	17'-4"	9.26	22.01	-
54"	IV	2,000	3,000	B	5 1/2"	4,000	0.50	2 x 8	8.5 x 3.5	15'-4"	29.29	0.30	2 x 8	5.0 x 3.0	16'-8"	19.52	48.81	0.55
							◆ 0.48	2 x 8	8.0 x 3.5	15'-4"	27.73	◆ 0.30	2 x 8	5.0 x 3.0	16'-8"	19.52	47.25	-
				C	6 1/4"	4,000	0.34	2 x 8	6.0 x 3.0	15'-4"	21.09	0.20	3 x 8	5.0 x 3.0	17'-4"	14.41	35.50	0.38
							◆ 0.33	2 x 8	5.5 x 3.0	15'-4"	19.52	◆ 0.20	3 x 8	5.0 x 3.0	17'-4"	14.41	33.93	-
54"	V	3,000	3,750	C	6 1/4"	6,000	0.58	2 x 8	10.0 x 4.0	15'-4"	34.37	0.35	2 x 8	6.0 x 3.0	17'-4"	23.84	58.21	0.64
							◆ 0.57	2 x 8	9.5 x 4.0	15'-4"	32.81	◆ 0.33	2 x 8	5.5 x 3.0	17'-4"	22.07	54.88	-

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76

DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE

WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT

Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	INNER CAGE Area Req'd	INNER CAGE Wire Spacing	INNER CAGE Wire Sizes	INNER CAGE Cage Length	INNER CAGE Cage Weight	OUTER CAGE Area Req'd	OUTER CAGE Wire Spacing	OUTER CAGE Wire Sizes	OUTER CAGE Cage Length	OUTER CAGE Cage Weight	Total Cage Weight	Alternate Elliptical Area
in.	-	**lbs./ft./ft.**	**lbs./ft./ft.**	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
60"	II	1,000	1,500	B	6"	4,000	0.25	2 x 8	4.5 x 2.5	16'-8"	17.40	0.15	2 x 8	2.5 x 2.5	18'-8"	11.87	29.27	0.28
													3 x 8	4.0 x 2.5	18'-8"	12.51	29.91	
							◆ 0.24	2 x 8	4.0 x 2.5	16'-8"	15.70	◆ 0.16	3 x 8	4.0 x 2.5	18'-8"	12.51	28.21	-
				C	6 3/4"	4,000	0.22	3 x 8	5.5 x 3.0	16'-8"	14.99	0.13	3 x 8	3.5 x 2.5	19'-4"	11.64	26.63	0.24
							◆ 0.22	3 x 8	5.5 x 3.0	16'-8"	14.99	◆ 0.12	3 x 8	3.0 x 2.5	19'-4"	10.33	25.32	-
60"	III	1,350	2,000	B	6"	4,000	0.34	2 x 8	6.0 x 3.0	16'-8"	22.92	0.20	3 x 8	5.0 x 3.0	18'-8"	15.52	38.44	0.38
							◆ 0.33	2 x 8	5.5 x 3.0	16'-8"	21.22	◆ 0.20	3 x 8	5.0 x 3.0	18'-8"	15.52	36.74	-
60"	III	1,350	2,000	C	6 3/4"	4,000	0.25	2 x 8	4.5 x 2.5	16'-8"	17.40	0.15	2 x 8	2.5 x 2.5	19'-4"	12.30	29.70	0.28
													3 x 8	4.0 x 2.5	19'-4"	12.96	30.36	
							◆ 0.24	2 x 8	4.0 x 2.5	16'-8"	15.70	◆ 0.16	3 x 8	4.0 x 2.5	19'-4"	12.96	28.66	-
60"	IV	2,000	3,000	B	6"	5,000	0.59	2 x 8	10.0 x 4.0	16'-8"	37.36	0.35	2 x 8	6.0 x 3.0	18'-8"	25.67	63.03	0.66
							◆ 0.57	2 x 8	9.5 x 4.0	16'-8"	35.66	◆ 0.36	2 x 8	6.0 x 3.0	18'-8"	25.67	61.33	-
							QC	2 x 8	5.0 x 3.0	20'-8"	24.21							
							QM	2 x 8	5.0 x 3.0	4'-8"	5.47	FC	2 x 8	6.0 x 3.0	18'-8"	25.67	55.35	
				C	6 3/4"	4,000	0.41	2 x 8	7.0 x 3.0	16'-8"	26.32	0.25	2 x 8	4.5 x 2.5	19'-4"	20.18	46.50	0.46
							◆ 0.42	2 x 8	7.0 x 3.0	16'-8"	26.32	◆ 0.24	2 x 8	4.0 x 2.5	19'-4"	18.21	44.53	-
60"	V	3,000	3,750	C	6 3/4"	6,000	0.70	2 x 8	12.0 x 5.0	16'-8"	45.00	0.42	2 x 8	7.0 x 3.0	19'-4"	30.53	75.53	0.78
							◆ 0.69	2 x 8	11.5 x 5.0	16'-8"	43.30	◆ 0.42	2 x 8	7.0 x 3.0	19'-4"	30.53	73.83	-
							QC	2 x 8	6.0 x 3.0	20'-8"	28.42							
							QM	2 x 8	6.0 x 3.0	4'-8"	6.42	FC	2 x 8	7.0 x 3.0	19'-4"	30.53	65.37	
66"	II	1,000	1,500	B	6 1/2"	4,000	0.31	2 x 8	5.5 x 3.0	18'-0"	22.92	0.19	3 x 8	5.0 x 3.0	20'-8"	17.18	40.10	0.34
							◆ 0.30	2 x 8	5.0 x 3.0	18'-0"	21.08	◆ 0.18	3 x 8	4.5 x 2.5	20'-8"	15.25	36.33	-
				C	7 1/4"	4,000	0.25	2 x 8	4.5 x 2.5	18'-0"	18.79	0.15	2 x 8	2.5 x 2.5	21'-4"	13.57	32.36	0.28
													3 x 8	4.0 x 2.5	21'-4"	14.30	33.09	
							◆ 0.24	2 x 8	4.0 x 2.5	18'-0"	16.96	◆ 0.16	3 x 8	4.0 x 2.5	21'-4"	14.30	31.26	-

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT										
							INNER CAGE					OUTER CAGE					Total Cage Weight	Alternate Elliptical Area
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight		
in.	-	**lbs./ft./ft.**	**lbs./ft./ft.**	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
66"	III	1,350	2,000	B	6 1/2"	4,000	0.41	2 x 8	7.0 x 3.0	18'-0"	28.43	0.25	2 x 8	4.5 x 2.5	20'-8"	21.58	50.01	0.46
							◆ 0.42	2 x 8	7.0 x 3.0	18'-0"	28.43	◆ 0.24	2 x 8	4.0 x 2.5	20'-8"	19.47	47.90	-
				C	7 1/4"	4,000	0.31	2 x 8	5.5 x 3.0	18'-0"	22.92	0.19	3 x 8	5.0 x 3.0	21'-4"	17.73	40.65	0.34
							◆ 0.30	2 x 8	5.0 x 3.0	18'-0"	21.08	◆ 0.18	3 x 8	4.5 x 2.5	21'-4"	15.75	36.83	-
66"	IV	2,000	3,000	B	6 1/2"	5,000	0.69	2 x 8	11.5 x 5.0	18'-0"	46.76	0.41	2 x 8	7.0 x 3.0	20'-8"	32.64	79.40	0.77
							◆ 0.66	2 x 8	11.0 x 4.5	18'-0"	44.47	◆ 0.42	2 x 8	7.0 x 3.0	20'-8"	32.64	77.11	-
							QC	2 x 8	5.5 x 3.0	22'-8"	28.86							
							QM	2 x 8	5.5 x 3.0	4'-8"	5.94	FC	2 x 8	7.0 x 3.0	20'-8"	32.64	67.44	
				C	7 1/4"	4,000	0.51	2 x 8	8.5 x 3.5	18'-0"	34.39	0.31	2 x 8	5.5 x 3.0	21'-4"	27.16	61.55	0.57
							◆ 0.51	2 x 8	8.5 x 3.5	18'-0"	34.39	◆ 0.30	2 x 8	5.0 x 3.0	21'-4"	24.99	59.38	-
							QC	2 x 8	4.5 x 2.5	22'-8"	23.67							
							QM	2 x 8	4.5 x 2.5	4'-8"	4.87	FC	2 x 8	5.0 x 3.0	21'-4"	24.99	53.53	
66"	V	3,000	3,750	C	7 1/4"	6,000	0.84	(2) 2 x 8	7.0 x 3.0	18'-0"	56.86	0.50	2 x 8	8.5 x 3.5	21'-4"	40.76	97.62	0.93
							◆ 0.84	(2) 2 x 8	7.0 x 3.0	18'-0"	56.86	◆ 0.48	2 x 8	8.0 x 3.5	21'-4"	38.58	95.44	-
							QC	2 x 8	7.0 x 3.0	22'-8"	35.80	QC	2 x 8	4.0 x 2.5	26'-0"	24.49		
							QM	2 x 8	7.0 x 3.0	4'-8"	7.37	QM	2 x 8	4.0 x 2.5	5'-4"	5.02	72.68	
72"	II	1,000	1,500	B	7"	4,000	0.35	2 x 8	6.0 x 3.0	20'-0"	27.50	0.21	2 x 8	3.5 x 2.5	22'-8"	19.04	46.54	0.39
													3 x 8	5.5 x 3.0	22'-8"	20.38	47.88	
							◆ 0.36	2 x 8	6.0 x 3.0	20'-0"	27.50	◆ 0.20	3 x 8	5.0 x 3.0	22'-8"	18.84	46.34	-
				C	7 3/4"	4,000	0.30	2 x 8	5.0 x 3.0	20'-0"	23.43	0.18	3 x 8	4.5 x 2.5	22'-8"	16.73	40.16	0.33
72"	III	1,350	2,000	B	7"	4,000	0.49	2 x 8	8.5 x 3.5	20'-0"	38.21	0.29	2 x 8	5.0 x 3.0	22'-8"	26.55	64.76	0.54
							◆ 0.48	2 x 8	8.0 x 3.5	20'-0"	36.17	◆ 0.30	2 x 8	5.0 x 3.0	22'-8"	26.55	62.72	-
							QC	2 x 8	4.0 x 2.5	24'-8"	23.24							
							QM	2 x 8	4.0 x 2.5	5'-4"	5.02	FC	2 x 8	5.0 x 3.0	22'-8"	26.55	54.81	
				C	7 3/4"	4,000	0.36	2 x 8	6.0 x 3.0	20'-0"	27.50	0.22	3 x 8	5.5 x 3.0	22'-8"	20.38	47.88	0.40

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT										
							INNER CAGE					OUTER CAGE					
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Total Cage Weight	Alternate Elliptical Area
in.	-	lbs./ft./ft.	lbs./ft./ft.	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
72"	IV	2,000	3,000	B	7"	5,000	0.79	(2) 2 x 8	7.0 x 3.0	20'-0"	63.16	0.47	2 x 8	8.0 x 3.5	22'-8"	40.99	104.15	0.88
							◆ 0.78	(2) 2 x 8	6.5 x 3.0	20'-0"	59.08	◆ 0.45	2 x 8	7.5 x 3.0	22'-8"	38.11	97.19	-
							QC	2 x 8	6.5 x 3.0	24'-8"	36.44							
							QM	2 x 8	6.5 x 3.0	5'-4"	7.88	FC	2 x 8	7.5 x 3.0	22'-8"	38.11	82.43	
				C	7 3/4"	5,000	0.61	2 x 8	10.5 x 4.5	20'-0"	47.38	0.37	2 x 8	6.5 x 3.0	22'-8"	33.48	80.86	0.68
							◆ 0.60	2 x 8	10.0 x 4.0	20'-0"	44.83	◆ 0.36	2 x 8	6.0 x 3.0	22'-8"	31.17	76.00	-
							QC	2 x 8	5.0 x 3.0	24'-8"	28.89							
							QM	2 x 8	5.0 x 3.0	5'-4"	6.25	FC	2 x 8	6.0 x 3.0	22'-8"	31.17	66.31	
72"	V	3,000	3,750	C	7 3/4"	6,000	0.99	(2) 2 x 8	8.5 x 3.5	20'-0"	76.42	0.59	2 x 8	10.0 x 4.0	22'-8"	50.81	127.23	1.10
							◆ 0.96	(2) 2 x 8	8.0 x 3.5	20'-0"	72.34	◆ 0.60	2 x 8	10.0 x 4.0	22'-8"	50.81	123.15	-
							QC	2 x 8	8.0 x 3.5	24'-8"	44.61	QC	2 x 8	5.0 x 3.0	28'-0"	32.80		
							QM	2 x 8	8.0 x 3.5	5'-4"	9.64	QM	2 x 8	5.0 x 3.0	6'-0"	7.03	94.08	
78"	II	1,000	1,500	B	7 1/2"	4,000	0.40	2 x 8	7.0 x 3.0	21'-4"	33.69	0.24	2 x 8	4.0 x 2.5	24'-0"	22.61	56.30	0.44
							◆ 0.39	2 x 8	6.5 x 3.0	21'-4"	31.51	◆ 0.24	2 x 8	4.0 x 2.5	24'-0"	22.61	54.12	
				C	8 1/4"	4,000	0.35	2 x 8	6.0 x 3.0	21'-4"	29.34	0.21	2 x 8	3.5 x 2.5	24'-8"	20.72	50.06	0.39
													3 x 8	5.5 x 3.0	24'-8"	22.18	51.52	
							◆ 0.36	2 x 8	6.0 x 3.0	21'-4"	29.34	◆ 0.20	3 x 8	5.0 x 3.0	24'-8"	20.51	49.85	-
78"	III	1,350	2,000	B	7 1/2"	4,000	0.57	2 x 8	9.5 x 4.0	21'-4"	45.65	0.34	2 x 8	6.0 x 3.0	24'-0"	33.01	78.66	0.63
							◆ 0.57	2 x 8	9.5 x 4.0	21'-4"	45.65	◆ 0.33	2 x 8	5.5 x 3.0	24'-0"	30.56	76.21	-
							QC	2 x 8	5.0 x 3.0	26'-8"	31.23							
							QM	2 x 8	5.0 x 3.0	5'-4"	6.25	FC	2 x 8	5.5 x 3.0	24'-0"	30.56	68.04	
				C	8 1/4"	4,000	0.42	2 x 8	7.0 x 3.0	21'-4"	33.69	0.25	2 x 8	4.5 x 2.5	24'-8"	25.75	59.44	0.47
							◆ 0.42	2 x 8	7.0 x 3.0	21'-4"	33.69	◆ 0.24	2 x 8	4.0 x 2.5	24'-8"	23.24	56.93	-

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT											Alternate Elliptical Area
							INNER CAGE					OUTER CAGE					Total Cage Weight	
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight		
in.	-	lbs./ft./ft.	lbs./ft./ft.	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
78"	IV	2,000	3,000	C	8 1/4"	5,000	0.71	2 x 8	12.0 x 5.0	21'-4"	57.60	0.43	2 x 8	7.5 x 3.0	24'-8"	41.47	99.07	0.79
							◆ 0.69	2 x 8	11.5 x 5.0	21'-4"	55.42	◆ 0.42	2 x 8	7.0 x 3.0	24'-8"	38.95	94.37	-
							QC	2 x 8	6.0 x 3.0	26'-8"	36.67							
							QM	2 x 8	6.0 x 3.0	5'-4"	7.33	FC	2 x 8	7.0 x 3.0	24'-8"	38.95	82.95	
84"	II	1,000	1,500	B	8"	4,000	0.46	2 x 8	8.0 x 3.5	23'-4"	42.20	0.28	2 x 8	5.0 x 3.0	26'-0"	30.45	72.65	0.51
							◆ 0.45	2 x 8	7.5 x 3.0	23'-4"	39.23	◆ 0.27	2 x 8	4.5 x 2.5	26'-0"	27.15	66.38	-
				C	8 3/4"	4,000	0.41	2 x 8	7.0 x 3.0	23'-4"	36.85	0.25	2 x 8	4.5 x 2.5	26'-8"	27.84	64.69	0.46
							◆ 0.42	2 x 8	7.0 x 3.0	23'-4"	36.85	◆ 0.24	2 x 8	4.0 x 2.5	26'-8"	25.12	61.97	-
84"	III	1,350	2,000	B	8"	4,000	0.64	2 x 8	11.0 x 4.5	23'-4"	57.65	0.38	2 x 8	6.5 x 3.0	26'-0"	38.41	96.06	0.71
							◆ 0.63	2 x 8	10.5 x 4.5	23'-4"	55.27	◆ 0.39	2 x 8	6.5 x 3.0	26'-0"	38.41	93.68	-
							QC	2 x 8	5.5 x 3.0	28'-8"	36.50							
							QM	2 x 8	5.5 x 3.0	6'-0"	7.64	FC	2 x 8	6.5 x 3.0	26'-0"	38.41	82.55	
				C	8 3/4"	4,000	0.50	2 x 8	8.5 x 3.5	23'-4"	44.58	0.30	2 x 8	5.0 x 3.0	26'-8"	31.23	75.81	0.56
							QC	2 x 8	4.5 x 2.5	28'-8"	29.93							
							QM	2 x 8	4.5 x 2.5	6'-0"	6.26	FC	2 x 8	5.0 x 3.0	26'-8"	31.23	67.42	
84"	IV	2,000	3,000	C	8 3/4"	5,000	0.85	(2) 2 x 8	7.5 x 3.0	23'-4"	78.46	0.51	2 x 8	8.5 x 3.5	26'-8"	50.94	129.40	0.94
							◆ 0.84	(2) 2 x 8	7.0 x 3.0	23'-4"	73.70	◆ 0.48	2 x 8	8.0 x 3.5	26'-8"	48.22	121.92	-
							QC	2 x 8	7.0 x 3.0	28'-8"	45.27	QC	2 x 8	4.0 x 2.5	32'-8"	30.77		
							QM	2 x 8	7.0 x 3.0	6'-0"	9.48	QM	2 x 8	4.0 x 2.5	6'-8"	6.28	91.80	
90"	II	1,000	1,500	B	8 1/2"	4,000	0.51	2 x 8	8.5 x 3.5	24'-8"	47.12	0.31	2 x 8	5.5 x 3.0	28'-0"	35.65	82.77	0.57
							◆ 0.51	2 x 8	8.5 x 3.5	24'-8"	47.12	◆ 0.30	2 x 8	5.0 x 3.0	28'-0"	32.80	79.92	-
							QC	2 x 8	4.5 x 2.5	30'-8"	32.02							
							QM	2 x 8	4.5 x 2.5	6'-8"	6.96	FC	2 x 8	5.0 x 3.0	28'-0"	32.80	71.78	

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT											Alternate Elliptical Area
							INNER CAGE					OUTER CAGE					Total Cage Weight	
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight		
in.	-	**lbs./ft./ft.**	**lbs./ft./ft.**	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
90"	II	1,000	1,500	C	9 1/4"	4,000	0.48	2 x 8	8.0 x 3.5	24'-8"	44.61	0.29	2 x 8	5.0 x 3.0	28'-8"	33.58	78.19	0.53
							◆ 0.48	2 x 8	8.0 x 3.5	24'-8"	44.61	◆ 0.27	2 x 8	4.5 x 2.5	28'-8"	29.93	74.54	-
							QC	2 x 8	4.0 x 2.5	30'-8"	28.89							
							QM	2 x 8	4.0 x 2.5	6'-8"	6.28	FC	2 x 8	4.5 x 2.5	28'-8"	29.93	65.10	
90"	III	1,350	2,000	B	8 1/2"	5,000	0.69	2 x 8	11.5 x 5.0	24'-8"	64.08	0.41	2 x 8	7.0 x 3.0	28'-0"	44.22	108.30	0.77
							◆ 0.69	2 x 8	11.5 x 5.0	24'-8"	64.08	◆ 0.39	2 x 8	6.5 x 3.0	28'-0"	41.36	105.44	-
							QC	2 x 8	6.0 x 3.0	30'-8"	42.17							
							QM	2 x 8	6.0 x 3.0	6'-8"	9.17	FC	2 x 8	6.5 x 3.0	28'-0"	41.36	92.70	
				C	9 1/4"	5,000	0.59	2 x 8	10.0 x 4.0	24'-8"	55.29	0.35	2 x 8	6.0 x 3.0	28'-8"	39.42	94.71	0.66
							◆ 0.57	2 x 8	9.5 x 4.0	24'-8"	52.78	◆ 0.36	2 x 8	6.0 x 3.0	28'-8"	39.42	92.20	-
							QC	2 x 8	5.0 x 3.0	30'-8"	35.92							
							QM	2 x 8	5.0 x 3.0	6'-8"	7.81	FC	2 x 8	6.0 x 3.0	28'-8"	39.42	83.15	
96"	II	1,000	1,500	B	9"	4,000	0.57	2 x 8	9.5 x 4.0	26'-0"	55.63	0.34	2 x 8	6.0 x 3.0	30'-0"	41.26	96.89	0.63
							◆ 0.57	2 x 8	9.5 x 4.0	26'-0"	55.63	◆ 0.33	2 x 8	5.5 x 3.0	30'-0"	38.20	93.83	-
							QC	2 x 8	5.0 x 3.0	32'-8"	38.26							
							QM	2 x 8	5.0 x 3.0	6'-8"	7.81	FC	2 x 8	5.5 x 3.0	30'-0"	38.20	84.27	
				C	9 3/4"	4,000	0.55	2 x 8	9.5 x 4.0	26'-0"	55.63	0.33	2 x 8	5.5 x 3.0	30'-0"	38.20	93.83	0.61
							◆ 0.54	2 x 8	9.0 x 4.0	26'-0"	52.98	◆ 0.33	2 x 8	5.5 x 3.0	30'-0"	38.20	91.18	-
							QC	2 x 8	4.5 x 2.5	32'-8"	34.11							
							QM	2 x 8	4.5 x 2.5	6'-8"	6.96	FC	2 x 8	5.5 x 3.0	30'-0"	38.20	79.27	
96"	III	1,350	2,000	B	9"	5,000	0.76	(2) 2 x 8	6.5 x 3.0	26'-0"	76.82	0.46	2 x 8	8.0 x 3.5	30'-0"	54.25	131.07	0.84
							◆ 0.72	(2) 2 x 8	6.0 x 3.0	26'-0"	71.51	◆ 0.48	2 x 8	8.0 x 3.5	30'-0"	54.25	125.76	-
							QC	2 x 8	6.0 x 3.0	32'-8"	44.92	QC	2 x 8	4.0 x 2.5	36'-8"	34.54		
							QM	2 x 8	6.0 x 3.0	6'-8"	9.17	QM	2 x 8	4.0 x 2.5	7'-4"	6.91	95.54	

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT										
							INNER CAGE					OUTER CAGE					Total Cage Weight	Alternate Elliptical Area
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight		
in.	-	**lbs./ft./ft.**	**lbs./ft./ft.**	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
96"	III	1,350	2,000	C	9 3/4"	5,000	0.70	2 x 8	12.0 x 5.0	26'-0"	70.20	0.42	2 x 8	7.0 x 3.0	30'-0"	47.38	117.58	-
							QC	2 x 8	6.0 x 3.0	32'-8"	44.92							
							QM	2 x 8	6.0 x 3.0	6'-8"	9.17	FC	2 x 8	7.0 x 3.0	30'-0"	47.38	101.47	
102"	II	1,000	1,500	B	9 1/2"	5,000	0.68	2 x 8	11.5 x 5.0	28'-0"	72.75	0.41	2 x 8	7.0 x 3.0	31'-4"	49.48	122.23	-
							QC	2 x 8	6.0 x 3.0	34'-8"	47.68							
							QM	2 x 8	6.0 x 3.0	7'-4"	10.09	FC	2 x 8	7.0 x 3.0	31'-4"	49.48	107.25	
				C	10 1/4"	5,000	0.62	2 x 8	10.5 x 4.5	28'-0"	66.33	0.37	2 x 8	6.5 x 3.0	32'-0"	47.27	113.60	-
							QC	2 x 8	5.5 x 3.0	34'-8"	44.14							
							QM	2 x 8	5.5 x 3.0	7'-4"	9.34	FC	2 x 8	6.5 x 3.0	32'-0"	47.27	100.75	
102"	III	1,350	2,000	B	9 1/2"	5,000	0.90	(2) 2 x 8	7.5 x 3.0	28'-0"	94.15	0.54	2 x 8	9.0 x 4.0	31'-4"	63.85	158.00	-
							QC	2 x 8	7.5 x 3.0	34'-8"	58.28	QC	2 x 8	4.5 x 2.5	39'-4"	41.07		
							QM	2 x 8	7.5 x 3.0	7'-4"	12.33	QM	2 x 8	4.5 x 2.5	8'-0"	8.35	120.03	
				C	10 1/4"	5,000	0.83	(2) 2 x 8	7.0 x 3.0	28'-0"	88.44	0.50	2 x 8	8.5 x 3.5	32'-0"	61.13	149.57	-
							QC	2 x 8	7.0 x 3.0	34'-8"	54.75	QC	2 x 8	4.5 x 2.5	40'-0"	41.76		
							QM	2 x 8	7.0 x 3.0	7'-4"	11.58	QM	2 x 8	4.5 x 2.5	8'-0"	8.35	116.44	
108"	II	1,000	1,500	B	10"	5,000	0.76	(2) 2 x 8	6.5 x 3.0	29'-4"	86.66	0.46	2 x 8	8.0 x 3.5	33'-4"	60.28	146.94	-
							QC	2 x 8	6.5 x 3.0	36'-0"	53.18	QC	2 x 8	4.0 x 2.5	41'-4"	38.94		
							QM	2 x 8	6.5 x 3.0	7'-4"	10.83	QM	2 x 8	4.0 x 2.5	8'-8"	8.16	111.11	
				C	10 3/4"	5,000	0.70	2 x 8	12.0 x 5.0	29'-4"	79.20	0.42	2 x 8	7.0 x 3.0	34'-0"	53.69	132.89	-
							QC	2 x 8	6.0 x 3.0	36'-0"	49.51							
							QM	2 x 8	6.0 x 3.0	7'-4"	10.09	FC	2 x 8	7.0 x 3.0	34'-0"	53.69	113.29	

◆ Allowable alternate design per ASTM C76 Section 12.5.2.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

ASTM C 76 DESIGN REQUIREMENTS FOR REINFORCED CONCRETE PIPE							WELDED WIRE REINFORCEMENT - CIRCULAR REINFORCEMENT											Alternate Elliptical Area
							INNER CAGE					OUTER CAGE					Total Cage Weight	
Internal Diameter	Pipe Class	D-Load 0.01"	D-Load Ult.	Wall Thickness		Concrete Strength	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight	Area Req'd	Wire Spacing	Wire Sizes	Cage Length	Cage Weight		
in.	-	lbs./ft./ft.	lbs./ft./ft.	-	in.	psi	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	sq.in./ft.	in.	W or D	ft.-in.	lbs./ft.	lbs./ft.	sq.in./ft.
108"	III	1,350	2,000	B	10"	5,000	1.08	(2) 2 x 8	9.0 x 4.0	29'-4"	119.54	0.65	2 x 8	11.0 x 4.5	33'-4"	82.36	201.90	-
							QC	2 x 8	9.0 x 4.0	36'-0"	73.35	QC	2 x 8	5.5 x 3.0	41'-4"	52.63		
							QM	2 x 8	9.0 x 4.0	7'-4"	14.94	QM	2 x 8	5.5 x 3.0	8'-8"	11.03	151.95	
				C	10 3/4"	5,000	0.99	(2) 2 x 8	8.5 x 3.5	29'-4"	112.08	0.59	2 x 8	10.0 x 4.0	34'-0"	76.21	188.29	-
							QC	2 x 8	8.5 x 3.5	36'-0"	68.77	QC	2 x 8	5.0 x 3.0	42'-0"	49.19		
							QM	2 x 8	8.5 x 3.5	7'-4"	14.01	QM	2 x 8	5.0 x 3.0	8'-8"	10.15	142.12	

Key

QC - 450° Quadrant Cage

QM - 90° Quadrant Mat

FC - 360° Full Circular Cage

Note: Where quadrant designs appear below an alternate design identified by a ◆, the quadrant design represents the alternate design.

◆ Allowable alternate design per ASTM C76 Section 12.5.2.
Note: ASTM C76-97 was used as reference for the publication.

Wire size increments of 0.1 W-number and sizes larger than W12 are available.

APPENDIX A

METRIC CONVERSIONS FOR WELDED WIRE REINFORCEMENT

CIRCUMFERENTIAL SPACING

English	Metric
2"	51 mm
3"	76 mm
4"	102 mm

TRANSVERSE SPACING

English	Metric
4"	102 mm
6"	152 mm
8"	203 mm
12"	305 mm
16"	406 mm

CIRCUMFERENTIAL WIDTHS

English	Metric
68"	1727 mm
70"	1778 mm
87"	2210 mm
88"	2235 mm
90"	2286 mm
92"	2337 mm
93"	2362 mm
94"	2388 mm
95"	2413 mm
96"	2438 mm
97"	2464 mm
98"	2489 mm
108"	2743 mm
141"	3581 mm
142"	3607 mm

WIRE SIZE DESIGNATION

English (sq. in. x 100)	Metric (sq. mm)
W2.0	MW13
W2.5	MW16
W3.0	MW19
W3.5	MW23
W4.0	MW26
W4.5	MW29
W5.0	MW32
W5.5	MW35
W6.0	MW39
W6.5	MW42
W7.0	MW45
W7.5	MW48
W8.0	MW52
W8.5	MW55
W9.0	MW58
W9.5	MW61
W10.0	MW65
W10.5	MW68
W11.0	MW71
W11.5	MW74
W12.0	MW77

OVERHANGS

English	Metric
1/2"	13 mm
3/4"	19 mm
1"	25 mm
1 1/4"	32 mm
1 1/2"	38 mm
1 3/4"	44 mm
2"	51 mm

ROLL LENGTHS

English	Metric
300'	91.4 m
325'	99.1 m
350'	106.7 m
375'	114.3 m
400'	121.9 m
450'	137.2 m
500'	152.4 m
600'	182.9 m

CONVERSION FACTORS

inches	X	25.4	=	mm
W - Number	X	6.45	=	MW - Number
feet	X	0.3048	=	meters
mm	X	0.03937	=	inches
MW - Number	X	0.155	=	W - Number
meters	X	3.28	=	feet

EXAMPLE: 2 X 8 - W8.5 X W3.5 94" (+1,+0) X 375' ROLL

… metric conversion using tables above …

51 X 203 - MW55 X MW23 2388mm (+25,+0) X 114.3 m ROLL

APPENDIX B

WIRE PROPERTIES

W or D Number	Nominal Diameter (in.)	Area (sq. in.)	Weight (lb./ft.)
2.0	0.160	0.020	0.068
2.5	0.178	0.025	0.085
3.0	0.195	0.030	0.102
3.5	0.211	0.035	0.119
4.0	0.226	0.040	0.136
4.5	0.239	0.045	0.153
5.0	0.252	0.050	0.170
5.5	0.265	0.055	0.187
6.0	0.276	0.060	0.204
6.5	0.288	0.065	0.221
7.0	0.299	0.070	0.238
7.5	0.309	0.075	0.255
8.0	0.319	0.080	0.272
8.5	0.329	0.085	0.289
9.0	0.339	0.090	0.306
9.5	0.348	0.095	0.323
10.0	0.357	0.100	0.340
10.5	0.366	0.105	0.357
11.0	0.374	0.110	0.374
11.5	0.383	0.115	0.391
12.0	0.391	0.120	0.408
12.5	0.399	0.125	0.425
13.0	0.407	0.130	0.442
13.5	0.415	0.135	0.459
14.0	0.422	0.140	0.476
14.5	0.430	0.145	0.493
15.0	0.437	0.150	0.510
15.5	0.444	0.155	0.527
16.0	0.451	0.160	0.544
16.5	0.458	0.165	0.561
17.0	0.465	0.170	0.578
17.5	0.472	0.175	0.595
18.0	0.479	0.180	0.612
18.5	0.485	0.185	0.629
19.0	0.492	0.190	0.646
19.5	0.498	0.195	0.663
20.0	0.505	0.200	0.680