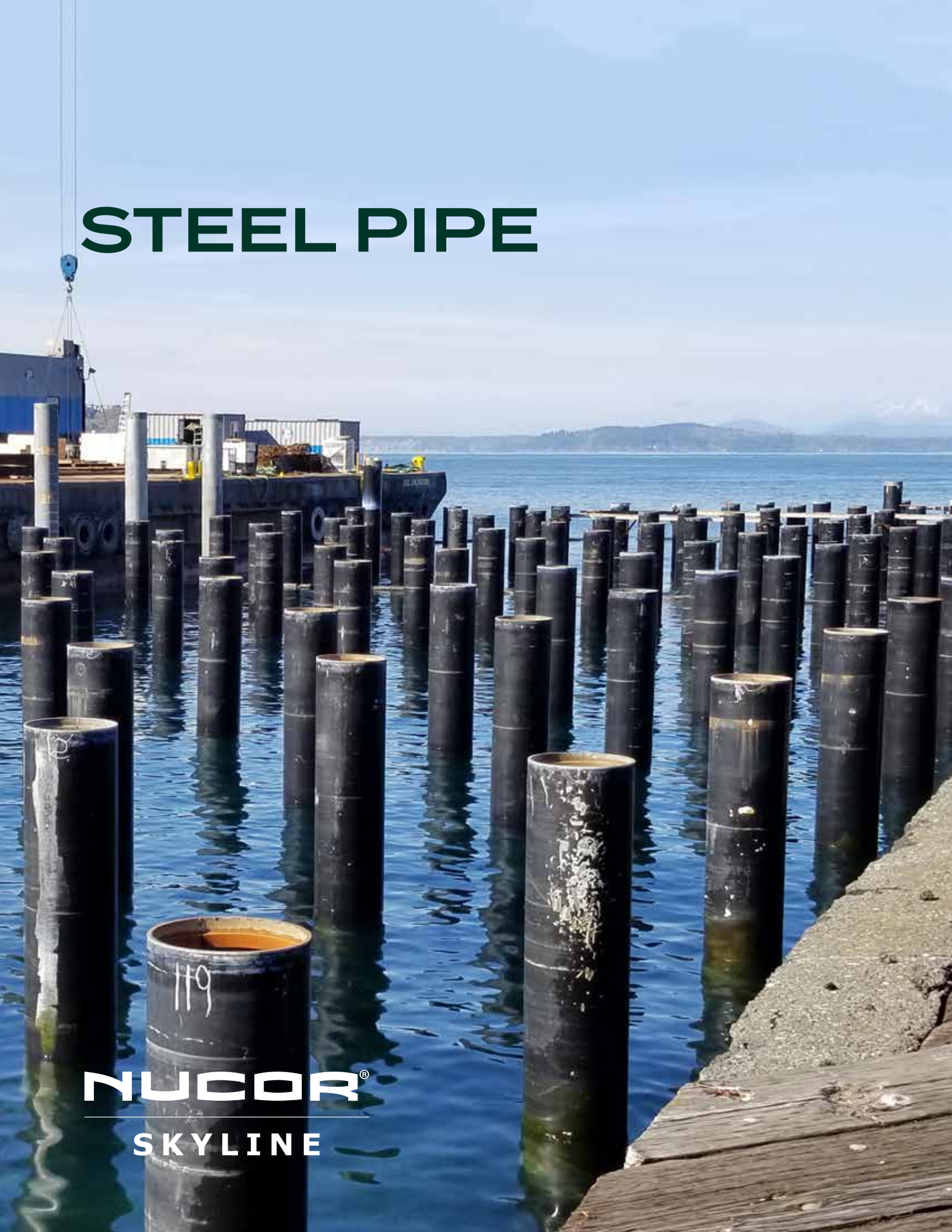
STEEL PIPE



NUCOR®

SKYLINE

NUCOR SKYLINE, YOUR TRUE PROJECT PARTNER

Offering the broadest range of steel foundation and geostructural products in the industry

Nation-wide manufacturing, fabrication, coating, and engineering expertise

Part of the Nucor family, North America's most diversified steel and steel products company

We are a premier steel foundation manufacturer and supplier, serving the North American market. Our flagship products include an unparalleled assortment of:

- H-Piles
- Pipe Piles
- Micropiles
- Solar Piles
- Piling Accessories
- Steel Sheet Piles
- Threaded Bars
- Combined Wall Systems
- Wide Flange and other Structural Sections

Nucor Skyline's knowledgeable engineering team works with owners, engineers, and contractors long before ground is broken. To ensure seamless project coordination and completion, our engineers propose solutions throughout all aspects of design, material selection, installation, and construction sequencing. Nucor Skyline's engineering support is extended even further to include provision of onsite assistance after a project has started. Our relationships extend beyond sales – we are your true project partner.

STEEL PIPE FROM NUCOR SKYLINE

Nucor Skyline has vast experience in manufacturing pipe piling products for the North American steel foundation industry. With our strategically located manufacturing plants, we can service the needs of any public or private project throughout the region.

- Wide Range of Diameters, Thicknesses and Lengths
  - ERW Straight Seam: From 2-3/8″ to 24″ OD; Up to 0.625″ Thickness
  - Spiralweld: Up to 120″ OD; 1″ Thickness
  - Rolled & Welded: Up to 204″ OD; 2.25″ Thickness
  - Micropile: 5.5″ – 20″ OD; Prime and Secondary
- Custom Lengths and Thicknesses
- Custom Fabrication Services
- Spiralweld Pipe Accepted by DOTs in Seismically Active Areas
- In-house and Third-Party Testing Capabilities
- Melted and Manufactured in the USA

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STEEL PIPE

PIPE PROPERTIES

Example is a 24" x 0.5" pipe.

Diameter in mm	Wall in mm	Weight lb/ft kg/m	Inside Diameter in mm	Cross Sectional Area in² cm²	Total Area of Pile in² cm²	Internal Area in² cm²	Internal Volume ft³/ft m³/m	External Coating Area ft²/ft m²/m	Moment of Inertia in⁴ cm⁴	Section Modulus in³ cm³	Radius of Gyration in cm
24 610	0.500 12.700	125.6 186.9	23.00 584.2	36.91 238.2	452.4 2,919	415.5 2,680	2.885 0.268	6.28 1.92	2,549 106,100	212.4 3,481	8.31 21.11

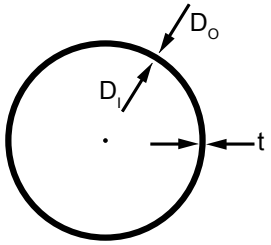
DIMENSIONS

Outside Diameter : D_0 = 24 in

Thickness : t = 0.5 in

Inside Diameter : $D_i = D_0 - 2 \times t$ = 23 in

Weight : $w_{pipe} = A_s \times 12 \text{ in/ft} \times 0.2836 \text{ lb/in}^3$ = 125.6 lb/ft



ENGINEERING PROPERTIES

Cross Sectional Area : $A_s = \frac{\pi (D_0^2 - D_i^2)}{4}$ = 36.91 in²

Total Area of Pile : $A_t = \pi (D_0/2)^2$ = 452.39 in²

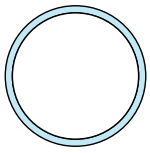
Internal Volume : $V_{internal} = \frac{\pi (D_i/2)^2}{12 \text{ in/ft}}$ = 2.885 ft³/ft

External Coating Area : $A_{coat} = \frac{(\pi \times D_0)}{12 \text{ in/ft}}$ = 6.28 ft²/ft

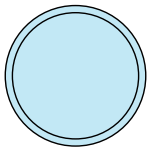
Moment of Inertia : $I = \frac{\pi (D_0^4 - D_i^4)}{64}$ = 2549.35 in⁴

Section Modulus : $S = \frac{I}{D_0/2}$ = 212.45 in³

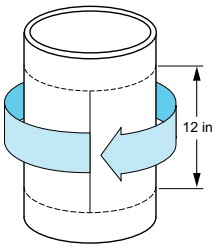
Radius of Gyration : $r = \frac{\sqrt{D_0^2 + D_i^2}}{4}$ = 8.31 in



CROSS SECTIONAL AREA



TOTAL AREA OF PILE



EXTERNAL COATING AREA

STEEL PIPE

Diameter	Wall	Weight	Inside Diameter	Cross Sectional Area	Total Area of Pile	Internal Area	Internal Volume	External Coating Area	Moment of Inertia	Section Modulus	Radius of Gyration	Maximum Available Yield Strength of A252		
												ERW	SW	R&W
in mm	in mm	lb/ft kg/m	in mm	in² cm²	in² cm²	in² cm²	ft³/ft m³/m	ft²/ft m²/m	in⁴ cm⁴	in³ cm³	in cm	ksi (MPa)		
2 ⅜ **60**	0.109 2.769	2.64 3.93	2.16 54.79	0.78 5.01	4.43 28.58	3.65 23.58	0.0254 0.0024	0.62 0.19	0.50 20.78	0.42 6.89	1.80 4.56	65 448	N/A	N/A
	0.154 3.912	3.66 5.44	2.07 52.50	1.08 6.93	4.43 28.58	3.36 21.65	0.0233 0.0022	0.62 0.19	0.67 27.71	0.56 9.19	1.78 4.51	65 448		
	0.188 4.775	4.40 6.54	2.00 50.77	1.29 8.33	4.43 28.58	3.14 20.25	0.0218 0.0020	0.62 0.19	0.78 32.38	0.66 10.74	1.76 4.47	65 448		
	0.218 5.537	5.03 7.48	1.94 49.25	1.48 9.53	4.43 28.58	2.95 19.05	0.0205 0.0019	0.62 0.19	0.87 36.13	0.73 11.98	1.75 4.43	65 448		
2 ⅞ **73**	0.120 3.048	3.53 5.26	2.64 66.93	1.04 6.70	6.49 41.88	5.45 35.18	0.0379 0.0035	0.75 0.23	0.99 41.09	0.69 11.25	1.84 4.66	60 414	N/A	N/A
	0.188 4.775	5.40 8.04	2.50 63.47	1.59 10.24	6.49 41.88	4.91 31.64	0.0341 0.0032	0.75 0.23	1.44 59.91	1.00 16.41	1.81 4.59	60 414		
	0.203 5.156	5.80 8.63	2.47 62.71	1.70 10.99	6.49 41.88	4.79 30.89	0.0332 0.0031	0.75 0.23	1.53 63.66	1.06 17.44	1.80 4.57	65 448		
	0.219 5.563	6.22 9.25	2.44 61.90	1.83 11.79	6.49 41.88	4.66 30.09	0.0324 0.0030	0.75 0.23	1.62 67.53	1.13 18.49	1.79 4.55	65 448		
	0.276 7.010	7.67 11.41	2.32 59.00	2.25 14.54	6.49 41.88	4.24 27.34	0.0294 0.0027	0.75 0.23	1.92 80.09	1.34 21.94	1.77 4.48	70 483		
3 ½ **89**	0.120 3.048	4.34 6.45	3.26 82.80	1.27 8.22	9.62 62.07	8.35 53.85	0.0580 0.0054	0.92 0.28	1.82 75.84	1.04 17.06	1.90 4.83	60 414	N/A	N/A
	0.188 4.775	6.66 9.91	3.12 79.35	1.96 12.62	9.62 62.07	7.67 49.45	0.0532 0.0049	0.92 0.28	2.69 112.0	1.54 25.20	1.87 4.76	60 414		
	0.203 5.156	7.16 10.65	3.09 78.59	2.10 13.57	9.62 62.07	7.52 48.51	0.0522 0.0049	0.92 0.28	2.87 119.4	1.64 26.85	1.87 4.74	65 448		
	0.219 5.563	7.68 11.43	3.06 77.77	2.26 14.56	9.62 62.07	7.36 47.51	0.0511 0.0048	0.92 0.28	3.05 127.0	1.74 28.57	1.86 4.72	65 448		
	0.276 7.010	9.51 14.16	2.95 74.88	2.80 18.04	9.62 62.07	6.83 44.04	0.0474 0.0044	0.92 0.28	3.66 152.3	2.09 34.26	1.83 4.66	70 483		
4 ½ **114**	0.120 3.048	5.62 8.36	4.26 108.2	1.65 10.65	15.90 102.6	14.25 91.96	0.0990 0.0092	1.18 0.36	3.96 164.9	1.76 28.86	2.03 5.16	60 414	N/A	N/A
	0.188 4.775	8.67 12.90	4.12 104.7	2.55 16.43	15.90 102.6	13.36 86.18	0.0928 0.0086	1.18 0.36	5.93 246.8	2.64 43.19	2.00 5.09	65 448		
	0.237 6.020	10.80 16.07	4.03 102.3	3.17 20.48	15.90 102.6	12.73 82.13	0.0884 0.0082	1.18 0.36	7.23 301.0	3.21 52.68	1.98 5.03	65 448		
	0.337 8.560	15.00 22.32	3.83 97.18	4.41 28.44	15.90 102.6	11.50 74.17	0.0798 0.0074	1.18 0.36	9.61 400.0	4.27 69.99	1.94 4.93	65 448		
	0.375 9.525	16.54 24.61	3.75 95.25	4.86 31.35	15.90 102.6	11.04 71.26	0.0767 0.0071	1.18 0.36	10.42 433.8	4.63 75.90	1.93 4.89	65 448		
6 ⅝ **168**	0.188 4.775	12.94 19.25	6.25 158.7	3.80 24.53	34.47 222.4	30.67 197.9	0.2130 0.0198	1.73 0.53	19.71 820.3	6.0 97.50	2.28 5.78	60 414	N/A	N/A
	0.280 7.112	18.99 28.26	6.07 154.1	5.58 36.01	34.47 222.4	28.89 186.4	0.2006 0.0186	1.73 0.53	28.14 1,171	8.5 139.2	2.25 5.70	65 448		
	0.375 9.525	25.06 37.28	5.88 149.2	7.36 47.50	34.47 222.4	27.11 174.9	0.1883 0.0175	1.73 0.53	36.08 1,502	10.89 178.5	2.21 5.62	65 448		
	0.432 10.973	28.60 42.56	5.76 146.3	8.41 54.23	34.47 222.4	26.07 168.2	0.1810 0.0168	1.73 0.53	40.49 1,685	12.2 200.3	2.20 5.58	70 483		
	0.500 12.700	32.74 48.72	5.63 142.9	9.62 62.07	34.47 222.4	24.85 160.3	0.1726 0.0160	1.73 0.53	45.42 1,890	13.71 224.7	2.17 5.52	70 483		
	0.562 14.275	36.43 54.20	5.50 139.7	10.70 69.06	34.47 222.4	23.77 153.3	0.1650 0.0153	1.73 0.53	49.61 2,065	14.98 245.4	2.15 5.47	75 517		

STEEL PIPE

Diameter	Wall	Weight	Inside Diameter	Cross Sectional Area	Total Area of Pile	Internal Area	Internal Volume	External Coating Area	Moment of Inertia	Section Modulus	Radius of Gyration	Maximum Available Yield Strength of A252		
												ERW	SW	R&W
in mm	in mm	lb/ft kg/m	in mm	in² cm²	in² cm²	in² cm²	ft³/ft m³/m	ft²/ft m²/m	in⁴ cm⁴	in³ cm³	in cm	ksi (MPa)		
7 **178**	0.250 6.350	18.04 26.84	6.50 165.1	5.30 34.20	38.48 248.3	33.18 214.1	0.2304 0.0214	1.83 0.56	30.23 1,258	8.6 141.6	2.39 6.07	65 448	N/A	N/A
	0.312 7.925	22.31 33.19	6.38 162.0	6.56 42.29	38.48 248.3	31.93 206.0	0.2217 0.0206	1.83 0.56	36.73 1,529	10.49 172.0	2.37 6.01	65 448		
	0.375 9.525	26.56 39.52	6.25 158.8	7.81 50.35	38.48 248.3	30.68 197.9	0.2131 0.0198	1.83 0.56	42.96 1788.0	12.27 201.1	2.35 5.96	65 448		
	0.500 12.700	34.74 51.70	6.00 152.4	10.21 65.87	38.48 248.3	28.27 182.4	0.1963 0.0182	1.83 0.56	54.24 2,258	15.50 254.0	2.31 5.85	65 448		
	0.562 14.275	38.68 57.56	5.88 149.3	11.37 73.33	38.48 248.3	27.12 175.0	0.1883 0.0175	1.83 0.56	59.34 2,470	16.95 277.8	2.29 5.80	65 448		
8 ⅝ **219**	0.188 4.775	16.96 25.23	8.25 209.5	4.98 32.15	58.43 376.9	53.44 344.8	0.3711 0.0345	2.26 0.69	44.36 1,846	10.29 168.6	2.98 7.58	70 483	N/A	N/A
	0.250 6.350	22.38 33.31	8.13 206.4	6.58 42.44	58.43 376.9	51.85 334.5	0.3601 0.0335	2.26 0.69	57.72 2,403	13.38 219.3	2.96 7.52	70 483		
	0.322 8.179	28.58 42.53	7.98 202.7	8.40 54.19	58.43 376.9	50.03 322.8	0.3474 0.0323	2.26 0.69	72.49 3,017	16.81 275.5	2.94 7.46	70 483		
	0.375 9.525	33.07 49.22	7.88 200.0	9.72 62.71	58.43 376.9	48.71 314.2	0.3382 0.0314	2.26 0.69	82.86 3,449	19.21 314.9	2.92 7.42	70 483		
	0.500 12.700	43.43 64.63	7.63 193.7	12.76 82.34	58.43 376.9	45.66 294.6	0.3171 0.0295	2.26 0.69	105.7 4,400	24.51 401.7	2.88 7.31	70 483		
	0.533 13.538	46.11 68.61	7.56 192.0	13.55 87.42	58.43 376.9	44.88 289.5	0.3116 0.0290	2.26 0.69	111.4 4,636	25.83 423.3	2.87 7.28	70 483		
	0.625 15.875	53.45 79.54	7.38 187.3	15.71 101.3	58.43 376.9	42.72 275.6	0.2967 0.0276	2.26 0.69	126.4 5,262	29.32 480.4	2.84 7.21	65 448		
9 ⅝ **244**	0.250 6.350	25.06 37.28	9.13 231.8	7.36 47.50	72.76 469.4	65.40 421.9	0.4541 0.0422	2.52 0.77	81.95 3,369	16.82 275.6	3.32 8.42	70 483	N/A	N/A
	0.312 7.925	31.06 46.22	9.00 228.6	9.13 58.89	72.76 469.4	63.63 410.52	0.4419 0.0411	2.52 0.77	99.08 4,124	20.59 337.4	3.29 8.37	70 483		
	0.375 9.525	37.08 55.18	8.88 225.4	10.90 70.31	72.76 469.4	61.86 399.1	0.4296 0.0399	2.52 0.77	116.7 4,859	24.26 397.5	3.27 8.31	70 483		
	0.500 12.700	48.77 72.58	8.63 219.1	14.33 92.47	72.76 469.4	58.43 376.9	0.4057 0.0377	2.52 0.77	149.6 6,228	31.09 509.5	3.23 8.21	80 552		
	0.545 13.843	52.90 78.72	8.54 216.8	15.55 100.3	72.76 469.4	57.21 369.1	0.3973 0.0369	2.52 0.77	160.8 6,693	33.41 547.5	3.22 8.17	85 586		
10 ¾ **273**	0.250 6.350	28.06 41.76	10.25 260.4	8.25 53.20	90.76 585.6	82.52 532.4	0.5730 0.0532	2.81 0.86	113.7 4,733	21.16 346.7	3.71 9.43	65 448	N/A	N/A
	0.312 7.925	34.81 51.81	10.13 257.2	10.23 66.01	90.76 585.6	80.53 519.6	0.5592 0.0520	2.81 0.86	139.5 5,805	25.95 425.2	3.69 9.38	65 448		
	0.375 9.525	41.59 61.89	10.00 254.0	12.22 78.86	90.76 585.6	78.54 506.7	0.5454 0.0507	2.81 0.86	164.7 6,854	30.64 502.0	3.67 9.32	65 448		
	0.500 12.700	54.79 81.53	9.75 247.7	16.10 103.9	90.76 585.6	74.66 481.7	0.5185 0.0482	2.81 0.86	212.0 8,822	39.43 646.2	3.63 9.22	65 448		
	0.593 15.062	64.39 95.82	9.56 242.9	18.92 122.1	90.76 585.6	71.84 463.5	0.4989 0.0463	2.81 0.86	244.8 10,190	45.55 746.5	3.60 9.14	65 448		
12 **305**	0.250 6.350	31.40 46.73	11.50 292.1	9.23 59.54	113.1 729.7	103.9 670.1	0.7213 0.0670	3.14 0.96	159.3 6,632	26.56 435.2	4.16 10.55	60 414	N/A	N/A
	0.312 7.925	38.98 58.01	11.38 289.0	11.46 73.91	113.1 729.7	101.6 655.7	0.7058 0.0656	3.14 0.96	195.8 8,149	32.63 534.7	4.13 10.50	60 414		
	0.335 8.509	41.77 62.16	11.33 287.8	12.28 79.20	113.1 729.7	100.8 650.5	0.7001 0.0650	3.14 0.96	209.0 8,699	34.83 570.8	4.13 10.48	60 414		
	0.375 9.525	46.60 69.35	11.25 285.8	13.70 88.36	113.1 729.7	99.40 641.3	0.6903 0.0641	3.14 0.96	231.6 9,640	38.60 632.5	4.11 10.44	60 414		
	0.500 12.700	61.47 91.47	11.00 279.4	18.06 116.5	113.1 729.7	95.03 613.1	0.6600 0.0613	3.14 0.96	299.2 12,450	49.86 817.1	4.07 10.34	60 414		
	0.625 15.875	76.00 113.1	10.75 273.1	22.33 144.1	113.1 729.7	90.76 585.6	0.6303 0.0586	3.14 0.96	362.3 15,080	60.39 989.6	4.03 10.23	60 414		

STEEL PIPE

Diameter	Wall	Weight	Inside Diameter	Cross Sectional Area	Total Area of Pile	Internal Area	Internal Volume	External Coating Area	Moment of Inertia	Section Modulus	Radius of Gyration	Maximum Available Yield Strength of A252		
												ERW	SW	R&W
in mm	in mm	lb/ft kg/m	in mm	in² cm²	in² cm²	in² cm²	ft³/ft m³/m	ft²/ft m²/m	in⁴ cm⁴	in³ cm³	in cm	ksi (MPa)		
12 ¾ **324**	0.250 6.350	33.41 49.71	12.25 311.2	9.82 63.34	127.7 823.7	117.9 760.4	0.819 0.076	3.34 1.02	191.8 7,984	30.09 493.1	4.42 11.23	70 483	N/A	N/A
	0.312 7.925	41.48 61.73	12.13 308.0	12.19 78.65	127.7 823.7	115.5 745.1	0.802 0.075	3.34 1.02	235.9 9,819	37.00 606.4	4.40 11.17	70 483		
	0.375 9.525	49.61 73.82	12.00 304.8	14.58 94.06	127.7 823.7	113.1 729.7	0.785 0.073	3.34 1.02	279.3 11,630	43.82 718.0	4.38 11.12	70 483		
	0.394 10.008	52.04 77.44	11.96 303.8	15.29 98.67	127.7 823.7	112.4 725.0	0.780 0.073	3.34 1.02	292.2 12,161	45.83 751.0	4.37 11.10	70 483		
	0.406 10.312	53.58 79.73	11.94 303.2	15.74 101.6	127.7 823.7	111.9 722.1	0.777 0.072	3.34 1.02	300.2 12,500	47.09 771.7	4.37 11.09	70 483		
	0.500 12.700	65.48 97.44	11.75 298.5	19.24 124.1	127.7 823.7	108.4 699.6	0.753 0.070	3.34 1.02	361.5 15,050	56.7 929.4	4.34 11.01	70 483		
	0.525 13.335	68.61 102.1	11.70 297.2	20.16 130.1	127.7 823.7	107.5 693.6	0.747 0.069	3.34 1.02	377.4 15,710	59.20 970.0	4.33 10.99	70 483		
	0.687 17.450	88.59 131.8	11.38 289.0	26.04 168.0	127.7 823.7	101.6 655.7	0.706 0.066	3.34 1.02	475.1 19,780	74.53 1,221	4.27 10.85	70 483		
14 **356**	0.219 5.563	32.26 48.01	13.56 344.5	9.48 61.17	153.9 993.1	144.5 932.0	1.003 0.093	3.67 1.12	225.1 9,371	32.16 527.1	4.87 12.38	70 483	N/A	N/A
	0.250 6.350	36.75 54.68	13.50 342.9	10.80 69.67	153.9 993.1	143.1 923.5	0.994 0.092	3.67 1.12	255.3 10,630	36.47 597.7	4.86 12.35	70 483		
	0.312 7.925	45.65 67.94	13.38 339.8	13.42 86.56	153.9 993.1	140.5 906.6	0.976 0.091	3.67 1.12	314.4 13,090	44.91 736.0	4.84 12.30	70 483		
	0.375 9.525	54.62 81.28	13.25 336.6	16.05 103.6	153.9 993.1	137.9 889.6	0.958 0.089	3.67 1.12	372.8 15,520	53.25 872.6	4.82 12.24	70 483		
	0.438 11.125	63.50 94.50	13.12 333.3	18.66 120.4	153.9 993.1	135.3 872.7	0.939 0.087	3.67 1.12	429.5 17,880	61.36 1,005	4.80 12.19	70 483		
	0.500 12.700	72.16 107.4	13.00 330.2	21.21 136.8	153.9 993.1	132.7 856.3	0.922 0.086	3.67 1.12	483.8 20,140	69.11 1,132	4.78 12.13	70 483		
	0.625 15.875	89.36 133.0	12.75 323.9	26.26 169.4	153.9 993.1	127.7 823.7	0.887 0.082	3.67 1.12	588.5 24,500	84.08 1,377	4.73 12.02	70 483		
16 **406**	0.250 6.350	42.09 62.64	15.50 393.7	12.37 79.81	201.1 1,297	188.7 1,217	1.310 0.122	4.19 1.28	383.7 15,970	47.96 785.9	5.57 14.15	70 483	60 414	N/A
	0.312 7.925	52.32 77.86	15.38 390.6	15.38 99.21	201.1 1,297	185.7 1,198	1.289 0.120	4.19 1.28	473.2 19,700	59.16 969.4	5.55 14.09	70 483	60 414	
	0.375 9.525	62.64 93.21	15.25 387.4	18.41 118.8	201.1 1,297	182.7 1,178	1.268 0.118	4.19 1.28	562.1 23,400	70.26 1,151	5.53 14.04	70 483	60 414	
	0.406 10.312	67.68 100.7	15.19 385.8	19.89 128.3	201.1 1,297	181.2 1,169	1.258 0.117	4.19 1.28	605.0 25,180	75.62 1,239	5.52 14.01	70 483	60 414	
	0.500 12.700	82.85 123.3	15.00 381.0	24.35 157.1	201.1 1,297	176.7 1,140	1.227 0.114	4.19 1.28	731.9 30,470	91.49 1,499	5.48 13.93	70 483	60 414	
	0.625 15.875	102.7 152.9	14.75 374.7	30.19 194.8	201.1 1,297	170.9 1,102	1.187 0.110	4.19 1.28	893.5 37,190	111.7 1,830	5.44 13.82	70 483	60 414	
18 **457**	0.250 6.350	47.44 70.59	17.50 444.5	13.94 89.94	254.5 1,642	240.5 1,552	1.670 0.155	4.71 1.44	549.1 22,860	61.02 999.9	6.28 15.94	60 414	60 414	N/A
	0.312 7.925	59.00 87.79	17.38 441.4	17.34 111.9	254.5 1,642	237.1 1,530	1.647 0.153	4.71 1.44	678.2 28,230	75.36 1,235	6.25 15.89	60 414	60 414	
	0.375 9.525	70.66 105.1	17.25 438.2	20.76 134.0	254.5 1,642	233.71 1,508	1.623 0.151	4.71 1.44	806.6 33,570	89.63 1,469	6.23 15.83	60 414	60 414	
	0.500 12.700	93.54 139.2	17.00 431.8	27.49 177.3	254.5 1,642	227.0 1,464	1.576 0.146	4.71 1.44	1,053 43,840	117.0 1,918	6.19 15.72	60 414	60 414	
	0.625 15.875	116.1 172.8	16.75 425.5	34.12 220.1	254.5 1,642	220.4 1,422	1.530 0.142	4.71 1.44	1,289 53,660	143.2 2,347	6.15 15.61	N/A	60 414	

STEEL PIPE

Diameter	Wall	Weight	Inside Diameter	Cross Sectional Area	Total Area of Pile	Internal Area	Internal Volume	External Coating Area	Moment of Inertia	Section Modulus	Radius of Gyration	Maximum Available Yield Strength of A252		
												ERW	SW	R&W
in mm	in mm	lb/ft kg/m	in mm	in² cm²	in² cm²	in² cm²	ft³/ft m³/m	ft²/ft m²/m	in⁴ cm⁴	in³ cm³	in cm	ksi (MPa)		
20 **508**	0.312 7.925	65.67 97.72	19.38 492.2	19.30 124.5	314.2 2,027	294.9 1,902	2.048 0.190	5.24 1.60	935.3 38,930	93.5 1,533	6.96 17.68	60 414	60 414	N/A
	0.375 9.525	78.67 117.1	19.25 489.0	23.12 149.2	314.2 2,027	291.0 1,878	2.021 0.188	5.24 1.60	1,113 46,350	111.3 1,825	6.94 17.63	60 414	60 414	
	0.500 12.700	104.2 155.1	19.00 482.6	30.63 197.6	314.2 2,027	283.5 1,829	1.969 0.183	5.24 1.60	1,457 60,640	145.7 2,387	6.90 17.52	60 414	60 414	
	0.625 15.875	129.5 192.6	18.75 476.3	38.04 245.4	314.2 2,027	276.1 1,781	1.917 0.178	5.24 1.60	1,787 74,380	178.7 2,928	6.85 17.41	60 414	60 414	
24 **610**	0.312 7.925	79.01 117.6	23.38 593.8	23.22 149.8	452.4 2,919	429.2 2,769	2.980 0.277	6.28 1.92	1,629 67,800	135.7 2,224	8.38 21.27	60 414	60 414	N/A
	0.375 9.525	94.71 140.9	23.25 590.6	27.83 179.6	452.4 2,919	424.6 2,739	2.948 0.274	6.28 1.92	1,942 80,840	161.9 2,652	8.35 21.22	60 414	60 414	
	0.500 12.700	125.6 186.9	23.00 584.2	36.91 238.2	452.4 2,919	415.5 2,680	2.885 0.268	6.28 1.92	2,549 106,100	212.4 3,481	8.31 21.11	60 414	60 414	
	0.625 15.875	156.2 232.4	22.75 577.9	45.90 296.11	452.4 2,919	406.5 2,623	2.823 0.262	6.28 1.92	3,137 130,600	261.4 4,284	8.27 21.00	60 414	60 414	
	0.750 19.050	186.4 277.4	22.50 571.5	54.78 353.4	452.4 2,919	397.6 2,565	2.761 0.257	6.28 1.92	3,705 154,200	308.8 5,060	8.22 20.89	N/A	50 345	
	0.875 22.225	216.3 321.9	22.25 565.2	63.57 410.1	452.4 2,919	388.8 2,509	2.700 0.251	6.28 1.92	4,255 177,100	354.6 5,811	8.18 20.78		50 345	
	1.000 25.400	245.9 365.9	22.00 558.8	72.26 466.2	452.4 2,919	380.1 2,452	2.640 0.245	6.28 1.92	4,787 199,300	398.9 6,537	8.14 20.67		50 345	
30 **762**	0.312 7.925	99.02 147.3	29.38 746.2	29.10 187.7	706.9 4,560	677.8 4,373	4.71 0.44	7.85 2.39	3,206 133,500	213.8 3,503	10.50 26.66	N/A	60 414	N/A
	0.375 9.525	118.8 176.7	29.25 743.0	34.90 225.2	706.9 4,560	672.0 4,335	4.67 0.43	7.85 2.39	3,829 159,400	255.3 4,184	10.47 26.61		60 414	
	0.500 12.700	157.7 234.6	29.00 736.6	46.34 299.0	706.9 4,560	660.5 4,261	4.59 0.43	7.85 2.39	5,042 209,900	336.1 5,508	10.43 26.50		60 414	
	0.625 15.875	196.3 292.1	28.75 730.3	57.68 372.1	706.9 4,560	649.2 4,188	4.51 0.42	7.85 2.39	6,224 259,100	414.9 6,800	10.39 26.39		60 414	
	0.750 19.050	234.5 349.0	28.50 723.9	68.92 444.6	706.9 4,560	637.9 4,116	4.43 0.41	7.85 2.39	7,375 307,000	491.7 8,057	10.34 26.28		60 414	
	0.875 22.225	272.4 405.4	28.25 717.6	80.06 516.5	706.9 4,560	626.8 4,044	4.35 0.40	7.85 2.39	8,497 353,700	566.5 9,283	10.30 26.17		60 414	
	1.000 25.400	310.0 461.3	28.00 711.2	91.11 587.8	706.9 4,560	615.8 3,973	4.28 0.40	7.85 2.39	9,589 399,100	639.3 10,480	10.26 26.06		50 345	
36 **914**	0.375 9.525	142.8 212.5	35.25 895.4	41.97 270.8	1,018 6,567	975.9 6,296	6.78 0.63	9.43 2.87	6,659 277,200	369.9 6,062	12.60 31.99	N/A	60 414	60 414
	0.500 12.700	189.8 282.4	35.00 889.0	55.76 359.8	1,018 6,567	962.1 6,207	6.68 0.62	9.43 2.87	8,786 365,700	488.1 7,999	12.55 31.88		60 414	60 414
	0.625 15.875	236.4 351.7	34.75 882.7	69.46 448.1	1,018 6,567	948.4 6,119	6.59 0.61	9.43 2.87	10,870 452,400	603.8 9,894	12.51 31.77		60 414	60 414
	0.750 19.050	282.6 420.6	34.50 876.3	83.06 535.8	1,018 6,567	934.8 6,031	6.49 0.60	9.43 2.87	12,910 537,200	717.0 11,750	12.47 31.66		60 414	60 414
	0.875 22.225	328.6 488.9	34.25 870.0	96.55 622.9	1,018 6,567	921.3 5,944	6.40 0.59	9.43 2.87	14,900 620,200	827.8 13,560	12.42 31.55		50 345	60 414
	1.000 25.400	374.2 556.8	34.00 863.6	110.0 709.4	1,018 6,567	907.9 5,858	6.31 0.59	9.43 2.87	16,850 701,400	936.2 15,340	12.38 31.44		50 345	60 414

STEEL PIPE

Diameter	Wall	Weight	Inside Diameter	Cross Sectional Area	Total Area of Pile	Internal Area	Internal Volume	External Coating Area	Moment of Inertia	Section Modulus	Radius of Gyration	Maximum Available Yield Strength of A252		
												ERW	SW	R&W
in mm	in mm	lb/ft kg/m	in mm	in² cm²	in² cm²	in² cm²	ft³/ft m³/m	ft²/ft m²/m	in⁴ cm⁴	in³ cm³	in cm	ksi (MPa)		
42 **1067**	0.375 9.525	166.9 248.3	41.25 1,048	49.04 316.4	1,385 8,938	1,336 8,622	9.28 0.86	11.00 3.35	10,620 442,100	505.8 8,288	14.72 37.38	N/A	60 414	60 414
	0.500 12.700	221.8 330.1	41.00 1,041	65.19 420.6	1,385 8,938	1,320 8,518	9.17 0.85	11.00 3.35	14,040 584,200	668.4 10,950	14.67 37.27		60 414	60 414
	0.625 15.875	276.4 411.4	40.75 1,035	81.24 524.1	1,385 8,938	1,304 8,414	9.06 0.84	11.00 3.35	17,390 723,700	828.0 13,570	14.63 37.16		60 414	60 414
	0.750 19.050	330.7 492.2	40.50 1,029	97.19 627.1	1,385 8,938	1,288 8,311	8.95 0.83	11.00 3.35	20,680 860,700	984.7 16,140	14.59 37.05		60 414	60 414
	0.875 22.225	384.7 572.4	40.25 1,022	113.0 729.3	1,385 8,938	1,272 8,209	8.84 0.82	11.00 3.35	23,910 995,200	1,139 18,660	14.54 36.94		50 345	60 414
	1.000 25.400	438.3 652.2	40.00 1,016	128.8 831.0	1,385 8,938	1,257 8,107	8.73 0.81	11.00 3.35	27,080 1,127,000	1,290 21,130	14.50 36.83		50 345	60 414
48 **1219**	0.375 9.525	190.9 284.1	47.25 1,200	56.11 362.0	1,810 11,670	1,753 11,310	12.18 1.13	12.57 3.83	15,910 662,200	662.8 10,860	16.84 42.77	N/A	60 414	60 414
	0.500 12.700	253.9 377.8	47.00 1,194	74.61 481.4	1,810 11,670	1,735 11,190	12.05 1.12	12.57 3.83	21,050 876,000	876.9 14,370	16.79 42.66		60 414	60 414
	0.625 15.875	316.5 471.0	46.75 1,187	93.02 600.1	1,810 11,670	1,717 11,070	11.92 1.11	12.57 3.83	26,100 1,086,000	1,088 17,820	16.75 42.55		60 414	60 414
	0.750 19.050	378.8 563.7	46.50 1,181	111.3 718.3	1,810 11,670	1,698 10,960	11.79 1.10	12.57 3.83	31,080 1,294,000	1,295 21,220	16.71 42.44		60 414	60 414
	0.875 22.225	440.8 656.0	46.25 1,175	129.5 835.8	1,810 11,670	1680 10,840	11.67 1.08	12.57 3.83	35,970 1,497,000	1,499 24,560	16.66 42.33		60 414	60 414
	1.000 25.400	502.4 747.7	46.00 1,168	147.7 952.6	1,810 11,670	1,662 10,720	11.54 1.07	12.57 3.83	40,790 1,698,000	1,700 27,850	16.62 42.22		60 414	60 414
	1.250 31.750	624.7 929.6	45.50 1,156	183.6 1,184	1,810 11,670	1,626 10,490	11.29 1.05	12.57 3.83	50,190 2,089,000	2,091 34,270	16.53 42.00		N/A	60 414
	1.375 34.925	685.3 1,020	45.25 1,149	201.4 1,299	1,810 11,670	1,608 10,380	11.17 1.04	12.57 3.83	54,780 2,280,000	2,282 37,400	16.49 41.89			60 414
54 **1372**	0.375 9.525	215.0 319.9	53.25 1,353	63.18 407.6	2,290 14,780	2,227 14,370	15.47 1.44	14.14 4.31	22,710 945,300	841.1 13,780	18.96 48.16	N/A	60 414	70 483
	0.500 12.700	286.0 425.5	53.00 1,346	84.04 542.2	2,290 14,780	2,206 14,230	15.32 1.42	14.14 4.31	30,070 1,252,000	1,114 18,250	18.92 48.05		60 414	70 483
	0.625 15.875	356.6 530.7	52.75 1,340	104.8 676.1	2,290 14,780	2,185 14,100	15.18 1.41	14.14 4.31	37,330 1,554,000	1,382 22,650	18.87 47.94		60 414	70 483
	0.750 19.050	426.9 635.3	52.50 1,334	125.5 809.5	2,290 14,780	2,165 13,970	15.03 1.40	14.14 4.31	44,480 1,851,000	1,647 27,000	18.83 47.82		60 414	70 483
	0.875 22.225	496.9 739.5	52.25 1,327	146.0 942.2	2,290 14,780	2,144 13,830	14.89 1.38	14.14 4.31	51,530 2,145,000	1,909 31,280	18.79 47.71		60 414	70 483
	1.000 25.400	566.6 843.12	52.00 1,321	166.5 1,074	2,290 14,780	2,124 13,700	14.75 1.37	14.14 4.31	58,480 2,434,000	2,166 35,500	18.74 47.60		60 414	70 483
	1.250 31.750	704.9 1,049	51.50 1,308	207.1 1,336	2,290 14,780	2,083 13,440	14.47 1.34	14.14 4.31	72,090 3,001,000	2,670 43,750	18.66 47.38		N/A	60 414
	1.375 34.925	773.5 1,151	51.25 1,302	227.3 1,467	2,290 14,780	2,063 13,310	14.33 1.33	14.14 4.31	78,750 3,278,000	2,917 47,790	18.61 47.27			60 414
60 **1524**	0.375 9.525	239.0 355.7	59.25 1,505	70.24 453.2	2,827 18,240	2,757 17,790	19.15 1.78	15.71 4.79	31,220 1,299,000	1,041 17,050	21.08 53.55	N/A	N/A	70 483
	0.500 12.700	318.0 473.3	59.00 1,499	93.46 603.0	2,827 18,240	2,734 17,640	18.99 1.76	15.71 4.79	41,360 1,722,000	1,379 22,590	21.04 53.43		60 414	70 483
	0.625 15.875	396.7 590.3	58.75 1,492	116.6 752.1	2,827 18,240	2,711 17,490	18.83 1.75	15.71 4.79	51,380 2,139,000	1,713 28,070	20.99 53.32		60 414	70 483
	0.750 19.050	475.0 706.9	58.50 1,486	139.6 900.7	2,827 18,240	2,688 17,340	18.67 1.73	15.71 4.79	61,270 2,550,000	2,042 33,470	20.95 53.21		60 414	70 483
	0.875 22.225	553.0 823.0	58.25 1,480	162.5 1,049	2,827 18,240	2,665 17,190	18.51 1.72	15.71 4.79	71,040 2,957,000	2,368 38,800	20.91 53.10		60 414	70 483
	1.000 25.400	630.7 938.6	58.00 1,473	185.4 1,196	2,827 18,240	2,642 17,050	18.35 1.71	15.71 4.79	80,680 3,358,000	2,689 44,070	20.86 52.99		60 414	70 483

STEEL PIPE

Diameter	Wall	Weight	Inside Diameter	Cross Sectional Area	Total Area of Pile	Internal Area	Internal Volume	External Coating Area	Moment of Inertia	Section Modulus	Radius of Gyration	Maximum Available Yield Strength of A252		
												ERW	SW	R&W
in mm	in mm	lb/ft kg/m	in mm	in² cm²	in² cm²	in² cm²	ft³/ft m³/m	ft²/ft m²/m	in⁴ cm⁴	in³ cm³	in cm	ksi (MPa)		
60 **1524**	1.250 31.750	785.1 1,168	57.50 1,461	230.7 1,488	2,827 18,240	2,597 16,750	18.03 1.68	15.71 4.79	99,580 4,145,000	3,319 54,400	20.78 52.77	N/A	N/A	70 483
	1.500 38.100	938.1 1,396	57.00 1,448	275.7 1,779	2,827 18,240	2,552 16,460	17.72 1.65	15.71 4.79	118,000 4,912,000	3,934 64,460	20.69 52.55			60 414
72 **1829**	0.375 9.525	287.1 427.3	71.25 1,810	84.38 544.4	4,072 26,270	3,987 25,720	27.69 2.57	18.85 5.75	54,110 2,252,000	1,503 24,630	25.32 64.32	N/A	N/A	70 483
	0.500 12.700	382.2 568.7	71.00 1,803	112.3 724.6	4,072 26,270	3,959 25,540	27.49 2.55	18.85 5.75	71,770 2,987,000	1,994 32,670	25.28 64.21			70 483
	0.625 15.875	476.9 709.6	70.75 1,797	140.1 904.2	4,072 26,270	3,931 25,360	27.30 2.54	18.85 5.75	89,250 3,715,000	2,479 40,630	25.24 64.10		60 414	70 483
	0.750 19.050	571.3 850.1	70.50 1,791	167.9 1,083	4,072 26,270	3,904 25,180	27.11 2.52	18.85 5.75	106,500 4,435,000	2,960 48,500	25.19 63.99		60 414	70 483
	0.875 22.225	665.3 990.0	70.25 1,784	195.5 1,261	4,072 26,270	3,876 25,010	26.92 2.50	18.85 5.75	123,700 5,147,000	3,435 56,290	25.15 63.88		60 414	70 483
	1.000 25.400	759.0 1,129	70.00 1,778	223.1 1,439	4,072 26,270	3,848 24,830	26.73 2.48	18.85 5.75	140,600 5,851,000	3,905 63,990	25.10 63.77		60 414	70 483
	1.250 31.750	945.4 1,407	69.50 1,765	277.8 1,792	4,072 26,270	3,794 24,480	26.34 2.45	18.85 5.75	173,900 7,238,000	4,830 79,160	25.02 63.55		N/A	60 414
	1.500 38.100	1,130 1,682	69.00 1,753	332.2 2,143	4,072 26,270	3,739 24,120	25.97 2.41	18.85 5.75	206,500 8,595,000	5,736 94,000	24.93 63.33			60 414
84 **2134**	0.375 9.525	335.2 498.9	83.25 2,115	98.52 635.6	5,542 35,750	5,443 35,120	37.80 3.51	21.99 6.70	86,120 3,585,000	2,050 33,600	29.57 75.10	N/A	N/A	70 483
	0.500 12.700	446.3 664.2	83.00 2,108	131.2 846.2	5,542 35,750	5,411 34,910	37.57 3.49	21.99 6.70	114,300 4,758,000	2,722 44,600	29.52 74.99			70 483
	0.625 15.875	557.1 829.0	82.75 2,102	163.7 1,056	5,542 35,750	5,378 34,700	37.35 3.47	21.99 6.70	142,300 5,921,000	3,387 55,500	29.48 74.87		60 414	70 483
	0.750 19.050	667.5 993.3	82.50 2,096	196.2 1,266	5,542 35,750	5,346 34,490	37.12 3.45	21.99 6.70	169,900 7,074,000	4,046 66,310	29.43 74.76		60 414	70 483
	0.875 22.225	777.5 1,157	82.25 2,089	228.5 1,474	5,542 35,750	5,313 34,280	36.90 3.43	21.99 6.70	197,400 8,216,000	4,700 77,010	29.39 74.65		60 414	70 483
	1.000 25.400	887.3 1,320	82.00 2,083	260.8 1,682	5,542 35,750	5,281 34,070	36.67 3.41	21.99 6.70	224,600 9,347,000	5,347 87,620	29.35 74.54		60 414	70 483
	1.250 31.750	1,106 1,645	81.50 2,070	325.0 2,097	5,542 35,750	5,217 33,660	36.23 3.37	21.99 6.70	278,200 11,580,000	6,624 108,500	29.26 74.32		N/A	70 483
	1.500 38.100	1,323 1,969	81.00 2,057	388.8 2,508	5,542 35,750	5,153 33,250	35.78 3.32	21.99 6.70	330,900 13,770,000	7,878 129,100	29.17 74.10			70 483
	1.625 41.275	1,431 2,129	80.75 2,051	420.5 2,713	5,542 35,750	5,121 33,040	35.56 3.30	21.99 6.70	356,800 14,850,000	8,496 139,200	29.13 73.99			70 483
96 **2438**	0.375 9.525	383.3 570.4	95.25 2,419	112.7 726.8	7,238 46,700	7,126 45,970	49.48 4.60	25.13 7.66	128,800 5,360,000	2,683 43,960	33.81 85.87	N/A	N/A	70 483
	0.500 12.700	510.5 759.6	95.00 2,413	150.0 967.8	7,238 46,700	7,088 45,730	49.22 4.57	25.13 7.66	171,000 7,118,000	3,563 58,390	33.76 85.76			70 483
	0.625 15.875	637.2 948.3	94.75 2,407	187.3 1,208	7,238 46,700	7,051 45,490	48.97 4.55	25.13 7.66	212,900 8,863,000	4,436 72,700	33.72 85.65		60 414	70 483
	0.750 19.050	763.7 1,136	94.50 2,400	224.4 1,448	7,238 46,700	7,014 45,250	48.71 4.53	25.13 7.66	254,500 10,590,000	5,303 86,900	33.68 85.54		60 414	70 483
	0.875 22.225	889.8 1,324	94.25 2,394	261.5 1,687	7,238 46,700	6,977 45,010	48.45 4.50	25.13 7.66	295,800 12,310,000	6,162 101,000	33.63 85.43		60 414	70 483
	1.000 25.400	1,016 1,511	94.00 2,388	298.5 1,925	7,238 46,700	6,940 44,770	48.19 4.48	25.13 7.66	336,700 14,020,000	7,015 115,000	33.59 85.32		60 414	70 483
	1.250 31.750	1,266 1,884	93.50 2,375	372.1 2,401	7,238 46,700	6,866 44,300	47.68 4.43	25.13 7.66	417,600 17,380,000	8,700 142,600	33.50 85.10		N/A	70 483
	1.500 38.100	1,515 2,255	93.00 2,362	445.3 2,873	7,238 46,700	6,793 43,830	47.17 4.38	25.13 7.66	497,200 20,700,000	10,360 169,800	33.42 84.87			70 483
	1.750 44.450	1,763 2,624	92.50 2,350	518.2 3,343	7,238 46,700	6,720 43,360	46.67 4.34	25.13 7.66	575,600 23,960,000	11,990 196,500	33.33 84.65			70 483
	2.000 50.800	2,010 2,991	92.00 2,337	590.6 3,810	7,238 46,700	6,648 42,890	46.16 4.29	25.13 7.66	652,600 27,160,000	13,600 222,800	33.24 84.43			70 483

STEEL PIPE

Diameter	Wall	Weight	Inside Diameter	Cross Sectional Area	Total Area of Pile	Internal Area	Internal Volume	External Coating Area	Moment of Inertia	Section Modulus	Radius of Gyration	Maximum Available Yield Strength of A252		
												ERW	SW	R&W
in mm	in mm	lb/ft kg/m	in mm	in² cm²	in² cm²	in² cm²	ft³/ft m³/m	ft²/ft m²/m	in⁴ cm⁴	in³ cm³	in cm	ksi (MPa)		
108 **2743**	0.375 9.525	431.4 642.0	107.3 2,724	126.8 818.0	9,161 59,100	9,034 58,280	62.74 5.83	28.27 8.62	183,600 7,641,000	3400 55,710	38.05 96.65	N/A	N/A	70 483
	0.500 12.700	574.6 855.1	107.0 2,718	168.9 1,089	9,161 59,100	8,992 58,010	62.44 5.80	28.27 8.62	243,900 10,150,000	4,517 74,020	38.01 96.54			70 483
	0.625 15.875	717.4 1,068	106.8 2,711	210.8 1,360	9,161 59,100	8,950 57,740	62.15 5.77	28.27 8.62	303,900 12,650,000	5,627 92,210	37.96 96.43		60 414	70 483
	0.750 19.050	859.9 1,280	106.5 2,705	252.7 1,630	9,161 59,100	8,908 57,470	61.86 5.75	28.27 8.62	363,400 15,120,000	6,729 110,300	37.92 96.32		60 414	70 483
	0.875 22.225	1,002 1,491	106.3 2,699	294.5 1,900	9,161 59,100	8,866 57,200	61.57 5.72	28.27 8.62	422,400 17,580,000	7,823 128,200	37.88 96.20		60 414	70 483
	1.000 25.400	1,144 1,702	106.0 2,692	336.2 2,169	9,161 59,100	8,825 56,930	61.28 5.69	28.27 8.62	481,100 20,030,000	8,910 146,000	37.83 96.09		60 414	70 483
	1.250 31.750	1,426 2,123	105.5 2,680	419.2 2,705	9,161 59,100	8,742 56,400	60.71 5.64	28.27 8.62	597,200 24,860,000	11,060 181,200	37.74 95.87		N/A	70 483
	1.500 38.100	1,708 2,541	105.0 2,667	501.9 3,238	9,161 59,100	8,659 55,860	60.13 5.59	28.27 8.62	711,700 29,620,000	13,180 216,000	37.66 95.65			70 483
	1.750 44.450	1,988 2,958	104.5 2,654	584.1 3,769	9,161 59,100	8,577 55,330	59.56 5.53	28.27 8.62	824,500 34,320,000	15268.94 250,200	37.57 95.43			70 483
	2.000 50.800	2,266 3,372	104.0 2,642	666.0 4,297	9,161 59,100	8,495 54,810	58.99 5.48	28.27 8.62	935,800 38,950,000	17,330 284,000	37.48 95.21			70 483
120 **3048**	0.375 9.525	479.6 713.6	119.3 3,029	140.9 909.2	11,310 72,970	11,170 72,060	77.56 7.21	31.42 9.58	252,100 10,490,000	4,202 68,850	42.29 107.4	N/A	N/A	70 483
	0.500 12.700	638.7 950.5	119.0 3,023	187.7 1,211	11,310 72,970	11,120 71,750	77.24 7.18	31.42 9.58	335,100 13,950,000	5,585 91,510	42.25 107.3			70 483
	0.625 15.875	797.6 1,187	118.8 3,016	234.4 1,512	11,310 72,970	11,080 71,450	76.91 7.15	31.42 9.58	417,500 17,380,000	6,959 114,000	42.21 107.2		60 414	70 483
	0.750 19.050	956.1 1,423	118.5 3,010	281.0 1,813	11,310 72,970	11,030 71,150	76.59 7.12	31.42 9.58	499,500 20,790,000	8,325 136,400	42.16 107.1		60 414	70 483
	0.875 22.225	1,114 1,658	118.3 3,004	327.5 2,113	11,310 72,970	10,980 70,850	76.27 7.09	31.42 9.58	580,900 24,180,000	9,682 158,700	42.12 107.0		60 414	70 483
	1.000 25.400	1272 1,893	118.0 2,997	373.8 2,412	11,310 72,970	10,940 70,550	75.94 7.06	31.42 9.58	661,800 27,550,000	11,030 180,800	42.07 106.9		60 414	70 483
	1.250 31.750	1,587 2,361	117.5 2,985	466.3 3,009	11,310 72,970	10,840 69,960	75.30 7.00	31.42 9.58	822,100 34,220,000	13,700 224,500	41.99 106.6		N/A	70 483
	1.500 38.100	1,900 2,828	117.0 2,972	558.4 3,603	11,310 72,970	10,750 69,360	74.66 6.94	31.42 9.58	980,300 40,800,000	16,340 267,700	41.90 106.4			70 483
	1.750 44.450	2,212 3,292	116.5 2,959	650.1 4,194	11,310 72,970	10,660 68,770	74.03 6.88	31.42 9.58	1,137,000 47,310,000	18,940 310,400	41.81 106.2			70 483
	2.000 50.800	2,523 3,754	116.0 2,946	741.4 4,783	11,310 72,970	10,570 68,180	73.39 6.82	31.42 9.58	1,291,000 53,730,000	21,510 352,500	41.73 106.0			70 483
132 **3353**	0.500 12.700	702.9 1,046	131.0 3,327	206.6 1,333	13,680 88,290	13,480 86,960	93.60 8.70	34.56 10.53	446,500 18,580,000	6,765 110,900	46.49 118.1	N/A	N/A	70 483
	0.625 15.875	877.8 1,306	130.8 3,321	258.0 1,664	13,680 88,290	13,430 86,620	93.24 8.66	34.56 10.53	556,500 23,160,000	8,432 138,200	46.45 118.0			70 483
	0.750 19.050	1,052 1,566	130.5 3,315	309.3 1,995	13,680 88,290	13,380 86,290	92.89 8.63	34.56 10.53	665,900 27,720,000	10,090 165,300	46.40 117.9			70 483
	0.875 22.225	1,227 1,825	130.3 3,308	360.4 2,325	13,680 88,290	13,320 85,960	92.53 8.60	34.56 10.53	774,700 32,250,000	11,740 192,400	46.36 117.8			70 483
	1.000 25.400	1,400 2,084	130.0 3,302	411.5 2,655	13,680 88,290	13,270 85,630	92.18 8.56	34.56 10.53	882,900 36,750,000	13,380 219,200	46.32 117.6			70 483
	1.250 31.750	1,747 2,600	129.5 3,289	513.5 3,313	13,680 88,290	13,170 84,980	91.47 8.50	34.56 10.53	1,097,000 45,670,000	16,630 272,500	46.23 117.4			70 483
	1.500 38.100	2,093 3,114	129.0 3,277	615.0 3,968	13,680 88,290	13,070 84,320	90.76 8.43	34.56 10.53	1,309,000 54,500,000	19,840 325,100	46.14 117.2			70 483
	1.750 44.450	2,437 3,626	128.5 3,264	716.1 4,620	13,680 88,290	12,970 83,670	90.06 8.37	34.56 10.53	1,519,000 63,220,000	23,010 377,100	46.05 117.0			70 483
	2.000 50.800	2,779 4,136	128.0 3,251	816.8 5,270	13,680 88,290	12,870 83,020	89.36 8.30	34.56 10.53	1,726,000 71,840,000	26,150 428,500	45.97 116.8			70 483

STEEL PIPE

Diameter	Wall	Weight	Inside Diameter	Cross Sectional Area	Total Area of Pile	Internal Area	Internal Volume	External Coating Area	Moment of Inertia	Section Modulus	Radius of Gyration	Maximum Available Yield Strength of A252		
												ERW	SW	R&W
in mm	in mm	lb/ft kg/m	in mm	in² cm²	in² cm²	in² cm²	ft³/ft m³/m	ft²/ft m²/m	in⁴ cm⁴	in³ cm³	in cm	ksi (MPa)		
144 **3658**	0.625 15.875	957.9 1,426	142.8 3,626	281.5 1,816	16,290 105,100	16,000 103,300	111.1 10.33	37.70 11.49	723,400 30,110,000	10,050 164,600	50.69 128.8	N/A	N/A	70 483
	0.750 19.050	1,149 1,709	142.5 3,620	337.5 2,178	16,290 105,100	15,950 102,900	110.8 10.29	37.70 11.49	865,800 36,040,000	12,020 197,100	50.65 128.6			70 483
	0.875 22.225	1,339 1,992	142.3 3,613	393.4 2,538	16,290 105,100	15,890 102,500	110.4 10.25	37.70 11.49	1,007,000 41,930,000	13,990 229,300	50.60 128.5			70 483
	1.000 25.400	1,529 2,275	142.0 3,607	449.2 2,898	16,290 105,100	15,840 102,200	110.0 10.22	37.70 11.49	1,148,000 47,800,000	15,950 261,400	50.56 128.4			70 483
	1.250 31.750	1,908 2,839	141.5 3,594	560.6 3,617	16,290 105,100	15,730 101,500	109.2 10.15	37.70 11.49	1,428,000 59,440,000	19,830 325,000	50.47 128.2			70 483
	1.500 38.100	2,285 3,400	141.0 3,581	671.5 4,332	16,290 105,100	15,610 100,700	108.4 10.07	37.70 11.49	1,705,000 70,950,000	23,680 388,000	50.38 128.0			70 483
	1.750 44.450	2,661 3,960	140.5 3,569	782.1 5,046	16,290 105,100	15,500 100,000	107.7 10.00	37.70 11.49	1,978,000 82,350,000	27,480 450,300	50.30 127.8			70 483
	2.000 50.800	3,036 4,518	140.0 3,556	892.2 5,756	16,290 105,100	15,390 99,310	106.9 9.93	37.70 11.49	2,249,000 93,620,000	31,240 511,900	50.21 127.5			70 483
156 **3962**	0.625 15.875	1,038 1,545	154.8 3,931	305.1 1,968	19,110 123,300	18,810 121,300	130.6 12.13	40.84 12.45	920,600 38,320,000	11800 193,400	54.93 139.5	N/A	N/A	80 552
	0.750 19.050	1,245 1,852	154.5 3,924	365.8 2360	19,110 123,300	18,750 121,000	130.2 12.10	40.84 12.45	1,102,000 45,870,000	14,130 231,500	54.89 139.4			80 552
	0.875 22.225	1,451 2,159	154.3 3,918	426.4 2,751	19,110 123,300	18,690 120,600	129.8 12.06	40.84 12.45	1,283,000 53,390,000	16,440 269,500	54.85 139.3			80 552
	1.000 25.400	1,657 2,466	154.0 3,912	486.9 3,142	19,110 123,300	18,630 120,200	129.4 12.02	40.84 12.45	1,462,000 60,870,000	18,750 307,200	54.80 139.2			80 552
	1.250 31.750	2,068 3,077	153.5 3,899	607.7 3,921	19,110 123,300	18,510 119,400	128.5 11.94	40.84 12.45	1,819,000 75,720,000	23,320 382,200	54.71 139.0			80 552
	1.500 38.100	2,477 3,687	153.0 3,886	728.1 4,697	19,110 123,300	18,390 118,600	127.7 11.86	40.84 12.45	2,173,000 90,430,000	27,850 456,400	54.63 138.8			80 552
	1.750 44.450	2,886 4,294	152.5 3,874	848.0 5,471	19,110 123,300	18,270 117,800	126.8 11.78	40.84 12.45	2,522,000 105,000,000	32339.61 530,000	54.54 138.5			80 552
	2.000 50.800	3,293 4,900	152.0 3,861	967.6 6,243	19,110 123,300	18,150 117,100	126.0 11.71	40.84 12.45	2,869,000 119,400,000	36,780 602,700	54.45 138.3			80 552
168 **4267**	0.750 19.050	1,341 1,995	166.5 4,229	394.1 2,542	22,170 143,000	21,770 140,500	151.2 14.05	43.98 13.41	1,378,000 57,350,000	16,400 268,800	59.13 150.2	N/A	N/A	80 552
	0.875 22.225	1,563 2,326	166.3 4,223	459.4 2,964	22,170 143,000	21,710 140,000	150.7 14.00	43.98 13.41	1,604,000 66,760,000	19,100 312,900	59.09 150.1			80 552
	1.000 25.400	1,785 2,657	166.0 4,216	524.6 3,385	22,170 143,000	21,640 139,600	150.3 13.96	43.98 13.41	1,829,000 76,130,000	21,770 356,800	59.04 150.0			80 552
	1.250 31.750	2,228 3,316	165.5 4,204	654.8 4,225	22,170 143,000	21,510 138,800	149.4 13.88	43.98 13.41	2,276,000 94,740,000	27,100 444,000	58.96 149.7			80 552
	1.500 38.100	2,670 3,973	165.0 4,191	784.6 5,062	22,170 143,000	21,380 138,000	148.5 13.80	43.98 13.41	2,719,000 113,200,000	32,370 530,500	58.87 149.5			80 552
	1.750 44.450	3,110 4,628	164.5 4,178	914.0 5,897	22,170 143,000	21,250 137,100	147.6 13.71	43.98 13.41	3,158,000 131,500,000	37,600 616,100	58.78 149.3			80 552
	2.000 50.800	3,549 5,281	164.0 4,166	1,043 6,729	22,170 143,000	21,120 136,300	146.7 13.63	43.98 13.41	3,593,000 149,600,00	42,780 701,000	58.69 149.1			80 552

For diameters over 168” or thicknesses over 2”, please inquire.

MAXIMUM ROLLED LENGTHS***

	16" OD and under		18" OD and over	
ERW	90 ft	27.4 m	115 ft	31.1 m
	12" OD and under		**12.75" OD and over**	
Spiralweld / Rolled & Welded	90 ft	27.4 m	115 ft	31.1 m

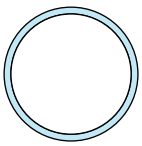
***Please inquire for longer lengths.

PRIME DOMESTIC

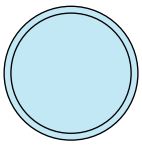
MICROPILE CASING

Outside Diameter in mm	Thickness in mm	Inside Diameter in mm	Weight lbs/ft kg/m	Cross Sectional Area in^2 cm^2	Total Area of Pile in^2 cm^2	Internal Volume ft^3/ft m^3/m	External Surface Area ft^2/ft m^2/m	Moment of Inertia in^4 cm^4	SECTION MODULUS Elastic in^3 cm^3	SECTION MODULUS Plastic in^3 cm^3
7 **177.8**	0.5 12.7	6 152.4	34.74 51.71	10.21 65.87	38.48 248.29	0.196 0.018	1.83 0.56	54.24 2257.7	15.5 253.96	21.17 346.86
8.625 **219.075**	0.5 12.7	7.625 193.675	43.43 64.63	12.76 82.34	58.43 376.94	0.32 0.029	2.26 0.69	105.72 4400.36	24.51 401.65	33.05 541.58
9.625 **244.475**	0.5 12.7	8.625 219.075	48.77 72.59	14.33 92.47	72.76 469.42	0.406 0.038	2.52 0.77	149.63 6228.24	31.09 509.52	41.67 682.92
10.75 **273.05**	0.5 12.7	9.75 247.65	54.79 81.54	16.1 103.88	90.76 585.56	0.518 0.048	2.81 0.86	211.95 8822.03	39.43 646.18	52.57 861.52
12.75 **323.85**	0.5 12.7	11.75 298.45	65.48 97.45	19.24 124.14	127.68 823.72	0.753 0.07	3.34 1.02	361.54 15048.59	56.71 929.36	75.07 1230.22
14 **355.6**	0.5 12.7	13 330.2	72.16 107.4	21.21 136.81	153.94 993.15	0.922 0.086	3.67 1.12	483.76 20135.45	69.11 1132.48	91.17 1493.95
16 **406.4**	0.5 12.7	15 381	82.85 123.31	24.35 157.08	201.06 1297.17	1.227 0.114	4.19 1.28	731.94 30465.73	91.49 1499.3	120.17 1969.18

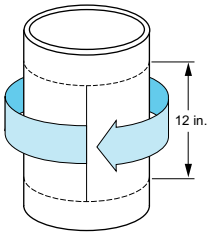
Contact your Nucor Skyline representative for additional diameters, lengths, and starter details.



CROSS SECTIONAL AREA



TOTAL AREA OF PILE



EXTERNAL SURFACE AREA

MICROPILE CASING ACCESSORIES

Nucor Skyline's Geostructural Group delivers complete accessory packages with your threaded casing. We understand the urgency of your project and stock a wide range of casing accessories for immediate delivery.

TOOLING ITEMS

In-house custom fabrication and machining is available for duplex and flange adapters to match casing and drill system requirements. We can also fabricate crossover subs to fit any existing tooling items. Nucor Skyline offers API drill rods, bits, and tool subs with select items in stock.

Nucor Skyline can provide threaded micropile casing up to 40 feet.

Female and male casing, cut and bundled to specifications

Casing accessories include duplex and flange adapters

API drill rods and casing subs are typical tooling items

Saver-subs available to fit all sizes of casing

MANUFACTURING PROCESS

ERW PIPE

Electric Resistance Welded (ERW) pipe is manufactured by cold forming a flat steel strip into a rounded tube by passing it through a series of forming rollers to obtain a longitudinal seam. The two edges are then simultaneously heated with a high frequency current and squeezed together to produce a bond. The longitudinal ERW seam does not require filler metal while impurities in the heat affected zone are extruded during the welding process.

UNCOILING & FLATTENING
Incoming coils are peeled and unwrapped for presentation into the flattener rolls. Flattening removes the coil set to produce a flat steel strip.

COIL JOINING
Coil ends are joined together with a butt weld to produce a continuous strip.

EDGE TRIMMING
Slitter blades and edge milling trims strip edges to provide the precise strip width required during the forming and ERW seam welding process.

FORMING
The forming process begins at the Breakdown Pass where the material is gradually bent from a flat steel strip into a rounded tube for presentation to the ERW seam welder.

WELDING
A high frequency electrical current flows through contact tips into the strip edges to produce the heat required for bonding the strip edges together as the material passes through the weld roll stand.

Quality Control
Once the welding is complete, the finished pipe is visually inspected by Quality Control (QC) and, if required, Ultrasonic (UT) testing is performed to ensure the weld is defect-free.

PIPE SIZING/STRAIGHTENING
The Sizing Section squeezes the welded pipe into the precise roundness, outer diameter, and straightness tolerances specified by the customer.

PIPE CUTTING
The flying cut-off saw attaches to the pipe as it is being produced and cuts the pipe to the length specified by the customer.

MANUFACTURING PROCESS

SPIRALWELD PIPE

The spiralweld manufacturing process is one of the most cost effective ways to produce steel pipe. Spiralweld pipe is manufactured from steel coil and typically utilizes a helical double submerged arc weld (DSAW). The mill setup offers a varying degree of flexibility, allowing for production of a wide range of pipe diameters and wall thicknesses. As a result, Nucor Skyline is able to offer spiralweld products for structural and non-structural applications.

UNCOILING
Upon receipt of the coil, it is placed on a horizontal un-coiler mandrel and fed into the straightener.

FLATTENing
The strip of coil is introduced into the flattener through a roll stand and the coil set is removed.

JOINING OF THE COIL ENDS
As the coil continues to move through the straightener, the leading and trailing edges of the strip are trimmed in preparation for butt welding – coil to coil.

EDGE MILLING
The edges of the coil are trimmed with carbide teeth to prepare for welding.

PIPE SPIRALING
The strip of coil enters the three roll apparatus composed of lead, buttress and mandrel roll sets. At this stage, the coil starts to form the spiral shape that will then become pipe.

PIPE WELDING
The welding system welds the pipe, first along the inside diameter and then along the outside diameter, using a submerged arc welding process.

Quality Control
Once the welding is complete, the finished pipe is visually inspected by Quality Control (QC) and, if required, Ultrasonic (UT) testing is performed to ensure the weld is defect-free.

PIPE CUT-OFF
Once the pipe reaches the desired length, the cut-off machine is engaged. Traveling with the pipe, a plasma torch provides the cut-off of the finished pipe. Specific end props, such as bevel or square cut ends, can be requested to allow for simpler splicing in the field.

MANUFACTURING PROCESS

ROLLED & WELDED PIPE

Rolled & welded pipe is one of the oldest processes of manufacturing steel pipe. This manufacturing process is utilized when the pipe wall thickness exceeds the capabilities of the ERW and spiralweld manufacturing processes.

PLATE
The raw material – pieces of flat steel plate – is received into our manufacturing plant.

CUTTING
A single flat sheet of steel plate is cut on a burning table using plasma or cutting gases. This plate is cut according to the required width and length for each individual can that will form the final product.

BEVELING
After the plate is cut, it is transferred to the beveling station where the plate edges are beveled and prepped for welding.

BENDING
After beveling, the plate is transferred to the bending rolls. Nucor Skyline uses a 4-roll system to produce a true cylinder, also referred to as a can.

WELDING
The can is then staged for longitudinal welding (Long Seam). During this process, the seam between the two plates is welded on both the inside and outside.

CIRCUMFERENTIAL WELDING
During this last step of the manufacturing process, cans are fit together using the submerged arc weld (SAW) process, according to customer requirements for specific lengths.

QUALITY CONTROL
Once the welding is complete, the finished pipe is visually inspected by Quality Control (QC) and, if required, Ultrasonic (UT) testing is performed to ensure the weld is defect-free.

FINISHED PIPE
The finished pipe is then removed and ready for delivery.

PRODUCT DETAIL

SPECIALTY FABRICATION

Nucor Skyline pipe mills are capable of a wide variety of fabrication services. Please do not hesitate to call for any fabrication needs.


E22 Connector Attachment


Cutting Shoes


Leffer Ring


Backing Rings


Pipe with Slots


Conical Pipe Points


Custom Fabrication: Oscillator Casing


Reducers


Custom Fabrication


Conical Pipe Points


Weld-on Splicer


End Plate

PRODUCT DETAIL

PIPE SPECIFICATIONS

Nucor Skyline pipe is manufactured according to the following pipe specifications which provide guidance on manufacturing processes, dimensional requirements and tolerances.

Available Steel Pipe Grades					
ASTM	Yield Strength		Manufacturing Process		
	ksi	MPa	ERW	Spiralweld	Rolled & Welded
A 139 Grade A	30	205	✔	✔	✔
A 139 Grade B	35	240	✔	✔	✔
A 139 Grade C	42	290	✔	✔	✔
A 139 Grade D	46	315	✔	✔	✔
A 139 Grade E	52	360	✔	✔	✔
A 252 Grade 1	30	205	✔	✔	✔
A 252 Grade 2	35	240	✔	✔	✔
A 252 Grade 3	45	310	✔	✔	✔
A 252 Grade 3 (Mod)	50	345	✔	✔	✔
A 252 Grade 3 (Mod)	60 - 80*	415 - 550*	✔	✔	✔
A 500 Grade B	42	290	✔		
A 500 Grade C	50	345	✔		
A 1085	50 - 70	345 - 450	✔		

Highlighted fields represent the most commonly used and readily available steel grades. Additional grades available upon request. Please call with any questions or special requests.

*Availability is dependent on pipe diameter and thickness.

ASTM A252

This specification was written specifically for steel pipe piles and is the most common specification for this application. "This specification covers nominal (average) wall steel pipe piles of cylindrical shape and applies to pipe piles in which the steel cylinder acts as a permanent load-carrying member, or as a shell to form cast-in-place concrete piles.... The piles shall be made by the seamless, electric resistance welded, flash welded, or fusion welded process. The seams of welded pipe piles shall be longitudinal, helical-butt, or helical-lap."

ASTM A139/A139M

"This specification covers five grades of electric-fusion (arc)-welded straight-seam or helical-seam steel pipe. Pipe of NPS 4 and larger with nominal (average) wall thickness of 1.0 in. [25.4mm] and less are covered. Listing of standardized dimensions are for reference. The grades of steel are pipe mill grades having mechanical properties which differ from standard plate grades. The pipe is intended for conveying liquid, gas or vapor."

Source: ASTM International

ASTM A500/A500M

"This specification covers cold-formed welded and seam-less carbon steel round, square, rectangular, or special shape structural tubing for welded, riveted, or bolted construction of bridges and buildings, and for general structural purposes. This tubing is produced in both welded and seamless sizes with a periphery of 88 in. [2235 mm] or less, and a specified wall thickness of 1 in. [25.4 mm] or less. Grade D requires heat treatment."

AWWA C200†

"This standard describes electrically but-welded straight-seam or spiral-seam pipe and seamless pipe, 6 in. (150mm) in nominal diameter and larger, for the transmission and distribution of water or for use in other water system facilities."

† Source: American Water Works Association (AWWA)

PRODUCT DETAIL

PIPE SPECIFICATIONS

The pipe specifications have limited chemical and mechanical property requirements of the steel plate, sheet, or coil the pipe is manufactured from. The following ASTM requirements address these properties in more detail and may be specified in addition to the pipe grades if the design professional deems them to be necessary.

Available Steel Specifications					
ASTM	Yield Strength		Manufacturing Process		
	ksi	MPa	ERW	Spiralweld	Rolled & Welded
A 36	36	250			✔
A 516 Grade 55	30	205			✔
A 516 Grade 60	32	220			✔
A 516 Grade 65	35	240			✔
A 516 Grade 70	38	260			✔
A 572 Grade 42	42	290			✔
A 572 Grade 50	50	345	✔	✔	✔
A 572 Grade 55	55	380	✔	✔	✔
A 572 Grade 60	60	415	✔	✔	✔
A 572 Grade 65	65	450	✔	✔	✔
A 588	50	345	✔	✔	✔
A 690	50	345		✔	✔
A 709	50	345	✔	✔	
A 1011/1018	50	345	✔	✔	
Abrasion Resistant	Brinell Hardness – 190		✔	✔	

Highlighted fields represent the most commonly used and readily available steel grades. Additional grades available upon request. Please call with any questions or special requests.

ASTM A1011/A1011M

"This specification covers hot-rolled, carbon, structural, high-strength low-alloy, high-strength low-alloy with improved formability, and ultra-high strength steel sheet and strip, in coils and cut lengths." Maximum coil thickness for this specification is 0.23 in.

ASTM A1018/A1018M

"This specification covers hot-rolled, heavy-thickness coils beyond the size limits of Specification A1011/A1011M." Coil thickness is from 0.23 in. to 1.000 in.

ASTM A572/A572M

"This specification covers five grades of high-strength low-alloy structural steel shapes, plates, sheet piling, and bars. Grades 42 [290], 50 [345], and 55 [380] are intended for riveted, bolted, or welded structures. Grades 60 [415] and 65 [450] are intended for riveted or bolted construction of bridges, or for riveted, bolted, or welded construction in other applications."

Source: ASTM International

ASTM A690/A690M

"This specification covers high-strength low-alloy nickel, copper, phosphorus steel H-piles and sheet piling of structural quality for use in the construction of dock walls, sea walls, bulkheads, excavations, and like applications in marine environments."

ASTM A709/A709M

"This specification covers carbon and high-strength low-alloy steel structural shapes, plates, and bars, quenched and tempered alloy steel, and stainless steel for structural plates intended for use in bridges."

PRODUCT DETAIL

QUALITY CONTROL

CERTIFICATIONS

All weld systems are qualified and certified to AWS D1.1. Our mills are quality certified by the Steel Plate Fabricators Association (SPFA). Additionally, each plant is staffed with Certified Weld Inspectors to assure a quality weld in every pipe.

Qualifications

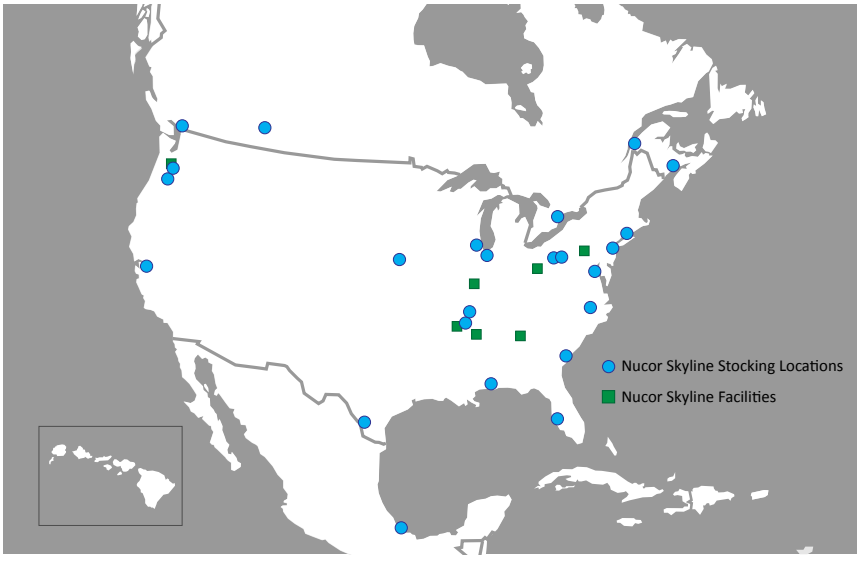
- American Welding Society (AWS)
  - AWS Section 3
  - AWS Section 4 / ASME Section IX
  - AWS Section 4 WPS – Weld Procedure Specification
  - AWS Section 4 PQR - Procedure Qualification Test Record
- Steel Plate Fabricators Association (SPFA) Quality Program
- Pre-qualified
- Qualified by Test
- Weld Quality Control Plan (WQCP)

Quality Assurance

- Non-destructive Testing (NDT)
  - Visual Inspection (VI)
  - Inline Ultrasonic Testing (UT)
  - Magnetic Particle Testing (MT)
  - Radiographic Testing / X-ray (RT)
  - Hydrostatic Testing
  - Dye Penetration Testing (PT)
  - Macro Etch Testing
- Destructive Testing
  - Tensile Strength Test: Base Metal/Across the Weld
  - Bend Test: Root, Face, Side
  - Charpy Impact Test (CVN): Base Metal, Weld Metal, Heat Affected Zone (HAZ)
- Custom Tests: Hoop Stresses, etc.
- Third-party Inspection
- UT, RT, VI, Etch and Weld Observations
- Procedure QA/QC Review

MANUFACTURING & STOCKING LOCATIONS

Nucor Skyline has several manufacturing locations and dozens of stocking locations throughout North America. Our proximity to the water, coupled with our extensive distribution network allows for fast and efficient delivery via truck, rail, or barge.



PRODUCT DETAIL

INCREASING DURABILITY

The durability of steel is a very important part of the design process. Although most steel buried in the ground does not need any protection from corrosion, there are cases where it is necessary. As a steel section corrodes, it loses strength and the designer must ensure that the section can carry its intended loads at the end of the design life. Determining the design life of a pipe is a straightforward process using the section properties, corrosion rate and any corrosion protection measures.

The corrosion rate of a particular environment is critical when calculating the design life. Different soils and types of water will have varying influences on the rate of loss. There are tables on the following page which give average values for the loss, in thickness, in soil and water. These values were gathered from measurements taken from actual jobsites. If there is historical information available locally, that information should be used instead. The engineer should determine the rate for both the inside and outside of the pipe. It should be noted that soil resistivity is sometimes used to determine the corrosiveness of a soil sample. This method for determining the corrosion rate does not take into account the level of oxygen in the soil and should not be used. The steel will not corrode without oxygen or extremely acidic soil.

Once the rate of loss has been determined, the reduced section properties and design life can be calculated. Increasing the design life of a steel pipe can be done in a variety of ways. Most of these will fall under three main categories; over design, corrosion rate reduction and steel protection.

Over design is most often done by increasing the thickness, diameter or steel grade. All of these methods will reduce the stress in the pipe. Although increasing the yield strength will not change the corrosion rate, it allows the pipe to carry the same loads with a smaller thickness.

Reducing the corrosion rate can be done with specialty steels (A690 and A588) or with cathodic protection. ASTM A690 reduces the corrosion rate for steel in the splash zone in salt water. ASTM A588 is an atmospheric corrosion resistant steel. Cathodic protection involves either sacrificial anodes or an impressed current system. Both systems create a battery cell to prevent the loss of material from the exposed steel. Galvanization is commonly used for atmospheric protection, but should not be used in the permanent immersion, tidal, or splash zones.

Protecting the steel through coating or painting is very common. Coating is relatively inexpensive and works well on exposed steel, but it can be damaged and once the steel is exposed it will corrode at the normal rate. The steel can also be protected using concrete encasement, jackets, or sleeves.

CALCULATING THE DESIGN LIFE OF A PIPE PILE

1. Design Pipe Pile
2. Determine Internal and External Corrosion Rates
3. Determine Maximum Allowable Stress
4. Calculate Reduced Diameter and Thickness that will Result in Maximum Allowable Stress
5. Calculate Section Loss
6. Calculate the Design Life Using Corrosion Rate and Section Loss
7. If the Design Life is Too Low, Choose from One of the Methods Below and Re-Calculate the Design Life

OVER DESIGN

- Increase Diameter
- Increase Thickness
- Increase Yield Strength
- Splice Thicker Pipe Section into Pile in Area of High Stress or High Corrosion

CORROSION REDUCTION

- A690 Steel — Salt Water Splash Zone Resistant Steel
- A588 Steel — Atmospheric Corrosion Resistant Steel
- Cathodic Protection
- Galvanization

BARRIER

- Coating
- Concrete Encasement
- Sleeves or Jackets

INCREASING DURABILITY

LOSS OF THICKNESS DUE TO CORROSION FOR PILES IN SOIL WITH OR WITHOUT GROUNDWATER

Required design working life	5 Years	25 Years	50 Years	75 Years	100 Years
	in / mm				
Undisturbed natural soils (sand, clay, schist, ...)	0.000 0.00	0.012 0.30	0.024 0.60	0.035 0.90	0.047 1.20
Polluted natural soils and industrial grounds	0.006 0.15	0.030 0.75	0.059 1.50	0.089 2.25	0.118 3.00
Aggressive natural soils (swamp, marsh, peat, ...)	0.008 0.20	0.039 1.00	0.069 1.75	0.098 2.50	0.128 3.25
Non-compacted and non-aggressive fills (clay, schist, sand, silt, ...)	0.007 0.18	0.028 0.70	0.047 1.20	0.067 1.70	0.087 2.20
Non-compacted and aggressive fills (ashes, slag, ...)	0.020 0.50	0.079 2.00	0.128 3.25	0.177 4.50	0.226 5.75

Notes:
1. Corrosion rates in compacted fills are lower than those in non-compacted ones. In compacted fills, the figures in the table should be divided by two.
2. The values given are only for guidance. Local conditions should be considered because they may affect the actual corrosion rate, which can be lower or higher than the average value given in the table.
3. The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

LOSS OF THICKNESS DUE TO CORROSION FOR PILES IN FRESH WATER OR IN SEA WATER

Required design working life	5 Years	25 Years	50 Years	75 Years	100 Years
	in / mm				
Common fresh water (river, ship canal, ...) in the zone of high attack (water line)	0.006 0.15	0.022 0.55	0.035 0.90	0.045 1.15	0.055 1.40
Very polluted fresh water (sewage, industrial effluent, ...) in the zone of high attack (water line)	0.012 0.30	0.051 1.30	0.091 2.30	0.130 3.30	0.169 4.30
Sea water in temperate climate in the zone of high attack (low water and splash zones)	0.022 0.55	0.074 1.90	0.148 3.75	0.220 5.60	0.295 7.50
Sea water in temperate climate in the zone of permanent immersion or in the intertidal zone	0.010 0.25	0.035 0.90	0.069 1.75	0.102 2.60	0.138 3.50

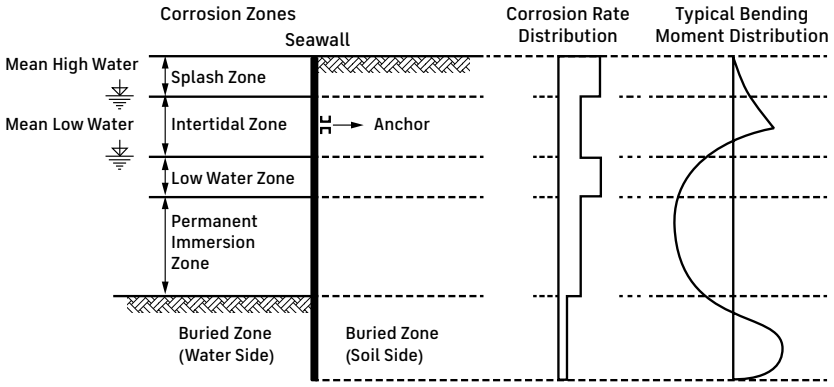
Notes:
1. The highest corrosion rate is usually found at the splash zone or at the low water level in tidal waters. However, in most cases, the highest stresses are in the permanent immersion zone.
2. The values given are only for guidance. Local conditions should be considered because they may affect the actual corrosion rate, which can be lower or higher than the average value given in the table.
3. The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

INCREASING DURABILITY

EXAMPLE DURABILITY CALCULATIONS

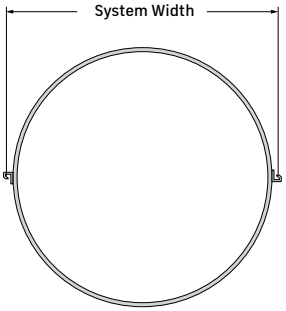
Since corrosion occurs at different rates depending on environment, one must design for each of these zones to determine which controls.

Depth	Pipe			Total Thickness Loss for 50 Years	Max. Ultimate Bending Moment
ft	Face 1	Face 2	Internal	in	K-ft/ft
0 - 5	Splash	Soil	Soil	0.22	25
10	Intertidal	Soil	Soil	0.141	500
15	Low Water	Soil	Soil	0.22	600
30	Immersion	Soil	Soil	0.141	650
60	Soil	Soil	Soil	0.096	400



For a high modulus wall, we will assume that we are using a pipe – pipe system with the system width equal to the pipe diameter plus a connector width of 1.25 in.

PIPE PROPERTIES	
Diameter	48 in
Thickness	0.5 in
F_y	50 ksi
System Width	49.25 in
S_x	10,857 in³



From the above, we must now calculate the minimum section modulus for each depth and then determine the minimum pipe thickness required based on the ultimate design loads provided.

Depth	Design Minimum Section Modulus	Min. Base Pipe Thickness	Min. Thickness with Corrosion
ft	in³/ft	in	in
0 - 5	6.0	0.014	0.124
10	120.0	0.277	0.347
15	144.0	0.333	0.443
30	156.0	0.362	0.432
60	96.0	0.221	0.269

From this, we can see that a 48"Ø x ½" Grade 50 pipe works.

APPLICATIONS OF STEEL PIPE

Steel pipe offers mechanical and physical characteristics that make it one of the most versatile construction products available. As a structural element, steel pipe remains unrivaled when compared to alternate materials. The flexibility offered by the manufacturing process, quality control and low production cost positions steel pipe to be the new shape of steel in many industries.

BEARING PILES

Driven steel piles are a very efficient way to carry loads from structures and one of the most tested elements in the construction industry. Pipe piles offer several advantages over other types of driven piles. The circular shape of the pipe means there is no weak axis and the interior of the pile can be augered out to remove obstructions or socket the pipe into rock. The pipe interior can be filled with reinforced concrete to increase the pile strength. Pipes can be manufactured to extremely long lengths and are easy to handle due to the bending strength-to-weight ratio and lack of a weak axis. The manufacturing process of pipe allows for millions of different combinations of diameters, thicknesses and steel grades.

The manufacturing of spiralweld pipe is especially flexible for thicknesses of one inch or less. The multitude of different diameters, cut to length sections, and speed of production, makes spiralweld a very attractive product for bearing piles.

Rolled and welded pipe is ideal in applications requiring larger-sized pipe or small custom quantities. The Tappan Zee Bridge in New York used tens of thousands of tons of 48 inch diameter pipe. Pipe piles of this size have the capability of carrying thousands of tons of axial load and very high lateral loads.

Several accessories are available to assist the contractor during installation. Inside and outside cutting shoes or conical points are good for hard driving conditions. Points are also useful if the interior of the pipe needs to be kept free of soil. Three different types of splicing mechanisms are also available. Backing rings are used when the pile needs a full penetration butt weld. Drive on and weld fit splicers are used for projects where speed is important and the full bending loads do not need to be carried through the splice.

DRILLED SHAFT CASING

Pipe casing, temporary or permanent, is often required during the construction of drilled shafts. The casing is used to hold the hole open while the reinforcement cage and concrete are installed. The ability to inspect the bottom of the hole and the elimination of any variations in the diameter of the finished drilled shaft makes for a much higher quality, finished pile. In the "Standard Guidelines for the Design and Installation of Pile Foundations" ASCE recommends a factor of safety that is 38% higher on the structural capacity of drilled shafts without casing, than those with casing.

APPLICATIONS OF STEEL PIPE

COMBINATION WALLS

Large diameter pipes have high bending strengths and are often used in combination sheet pile walls. The combination of large diameter pipe piles and steel sheet piles, which is often referred to as combi-walls, pipe-z walls or king pile walls, makes a very efficient system.

Like other combined walls, the king pile takes the majority of the load and the sheet pile transfers the load to the pipe and to the soil. In most cases, the sheet piles are between 60% and 80% of the length of the pipe pile. The king pile is almost always spiralweld pipe and the flexibility of the manufacturing process makes it easy for the designer to pinpoint the most efficient system. The design of the system assumes that there is no transfer of shear forces across the interlock. Therefore, the offset of the neutral axis, due to the sheet pile, is not taken into account.

$$Inertia_{system} = (Inertia_{pipe} + Inertia_{sheet\ pile}) / (System\ Width)$$

$$Modulus_{system} = Inertia_{system} / Radius_{pipe}$$

Pipe-Z walls are most often used for bulkhead walls for container, cruise and bulk terminals. In addition, they can be used for breakwaters or for high cantilevered retaining walls.

STRUCTURAL SECTIONS

The symmetry of pipe gives it the same bending strength, in any direction, which makes it an excellent product for the resistance of buckling. The stress required to buckle an axial member decreases with length. The radius of gyration has the opposite effect and increases the ability of a section to resist buckling. The W and HP sections have different radii of gyration (r_x and r_y) for the X and Y axes, while remaining constant for a pipe. The end result is that a pipe can take much higher loads for long, unsupported lengths.

Sample: 40 foot axially loaded section

Section	r_y	Weight	Buckling Load
	in	lbs/ft	k
W 12 x 53	2.48	53	103.9
HP 12 x 53	2.86	53	138.1
12" x 0.375"	4.11	46.6	252.6

The ability of pipes to resist buckling makes them ideally suited for the bracing of cofferdams and for large open structures.

APPLICATIONS OF STEEL PIPE

THREADED MICROPILE CASING

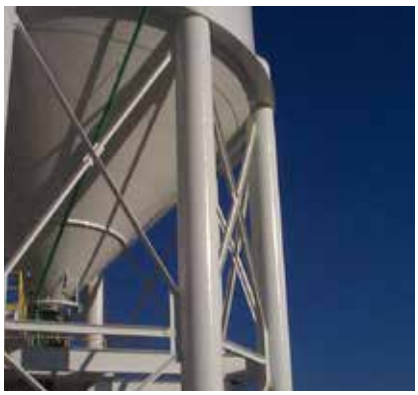
Micropiles are small diameter, bored cast-in-place piles, with most of the applied load being resisted by steel reinforcement. They are constructed by drilling a borehole, often using casing, then placing steel reinforcement and grouting the hole. Micropiles have a wide range of uses and are becoming a more mainstream method of supporting and resupporting foundations, seismic retrofits, stabilization of slopes and even earth retention.

Micropiles are usually designed in small clusters or groups, with each typically carrying an equal amount of load. These piles may also be designed with a batter to improve the lateral rigidity of the group. They can be designed to resist a combination of compression, tension and lateral forces.

Micropiles are an ideal pile for complex sites where low vibration or low noise levels are required, or where limited access such as low headroom and drilling is difficult. Other site conditions that make micropiles attractive are: obstructions, large cobbles or boulders, nearby sensitive structures, karst topography or high groundwater conditions. The unique characteristics of micropiles make them a perfect solution when other deep foundation methods are not suitable.

SIGN POLES, TOWERS, & TRANSMISSION LINES

Sign poles and towers are designed to resist large bending loads at the base of the structure. The availability and wide variety of thicknesses of large diameter pipe allow designers to pick the exact size needed to handle their particular project. Pipes can also be supplied in very long lengths, are simple to splice and easy to drill into hard ground. Reduction collars can facilitate the splicing of different diameters to make the design as efficient as possible.



MINING

Mining operations take place far beneath the surface in hazardous conditions. Personnel, equipment and air shafts are all integral parts of the mine. Vertical pipe sections are often used to construct the shafts. The large range of diameters and thicknesses make steel pipe the material of choice for various shaft requirements. Some of the shafts are hundreds, if not thousands, of feet long and pipe can be supplied in sections with the ends prepped for splicing. Bracing rings can be used to keep the pipe thicknesses to a minimum.

APPLICATIONS OF STEEL PIPE

JACKED & BORED

The placement of underground utilities is often done with jacked and bored pipe. Sections of pipe are pushed through the ground with hydraulic jacks between excavations or under a hill. The next section of pipe is then spliced onto the first and the jacking continues. Once the jacking is complete, the pipe is cleaned out to install the utilities. This allows the placement of utilities without extensive excavation which can disrupt roads, railroads, homes and businesses.

LINE PIPE

Welded steel pipe provides an effective method for transporting liquids, air, and gas. Steel pipe is pound per pound stronger than any other type of line pipe. Pipe can be designed to handle both the internal and external pressures of most applications. Welded steel pipe offers many advantages, such as: strength, economy and ease of installation. Nucor Skyline is SPFA certified and manufactures hydrostatically tested pipe in outside diameters ranging from 10¾″ to 90″. Our production process utilizes a double submerged arc weld process in both spiralweld and rolled & welded pipe. Hydrostatically tested pipe lengths range from 30′ to 60′, wall thicknesses from 0.250″ to 2.0″ and are produced to one of the following industry standards: AWWA C200/ASTM A139/ ASTM A134.

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As we are constantly evolving, here is where you'll find our latest updates.

06/23 Edition