NUCOR®

SKYLINE

Pipe

About Nucor Skyline

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A premier steel foundation manufacturer and supplier serving the U.S., Canada, Mexico, the Caribbean, Central America, and Colombia markets, Skyline Steel is a wholly-owned subsidiary of Nucor Corporation, the largest producer of steel in the United States. Nucor's backing complements and synergizes Nucor Skyline's internal strengths and empowers it to service its customers and the industry.

We have over twenty sales offices in North America and a robust infrastructure comprised of manufacturing, coating, and fabrication facilities; dozens of stocking locations; an efficiently-coordinated supply chain; exclusive engineering support; and the most comprehensive geostructural product offering from a single company. Collectively, these functions support a dynamic sales team that supplies hundreds of thousands of tons of steel foundation products to the industry every year.

Our flagship products include hot rolled and cold formed steel sheet piles, h-piles, spiralweld and rolled & welded pipe piles, threaded bar, micropiles, multi-strand anchor systems, hollow bar systems, accessories, structural sections and connectors. This product portfolio supports a variety of applications, including bridges, buildings, levees, locks and dams, ports, retaining walls, underground parking garages, environmental barrier walls, and wind towers. Of the products we manufacture and supply, 80% are made from recycled steel and are 100% recyclable.

Customer focus, our core philosophy

A strong customer focus has always been a legacy at Nucor Skyline. In fact, with us, customer service goes beyond the salesperson-contractor relationship and steel delivery— it continues beyond project completion. Our well-connected network of stockyards allows our sales team to supply customers with the materials needed to continue working and contractors can feel assured that steel will be available as needed, and on schedule.

Nucor Skyline, your true project partner

Nucor Skyline's knowledgeable engineering team works with owners, engineers, and contractors long before projects are advertised. To ensure seamless project coordination and completion, engineers propose solutions through all aspects of design, material selection, installation, and construction sequencing. Engineering support is extended even further to include provision of onsite assistance to ensure effective resolution after a project has started. Our relationship with the industry extends beyond sales—we are *your true project partner*.

Nucor Skyline's manufacturing capabilities include spiralweld pipe, rolled and welded pipe, cold form sheet piling, and threaded bar. To customize and protect these products, we own and operate fabrication and coating facilities throughout the United States.

Nucor Skyline Pipe

Product Highlights

- Wide Range of Diameters, Thicknesses and Lengths
  Spiralweld: Up to 120" OD; 1" Thickness
  Rolled & Welded: Up to 196" OD; 2" Thickness
- Height of Weld
  * Outside Diameter (OD): 1/16th of an inch or less
  * Inside Diameter (ID): 1/32nd of an inch or less
- Custom Lengths, Thicknesses and Fabrication
- Accepted by DOTs in Seismically Active Areas
- Nucor Skyline Spiralweld Pipe is Structurally Equal to American Petroleum Institute (API) Pipe*
- Destructive and Non-destructive In-house Testing
- Third-party Inspection (Visual and Ultrasonic)
- Hydrostatic Testing Capabilities

*According to full-scale university study conducted in 2009

Customized Production to Meet your Needs
Nucor Skyline's plants are equipped to meet the following specification requirements:

Welding

AWS D1.1 Full Penetration

Delivery Conditions & Standards

Nucor Skyline pipe is manufactured according to the following American Society of Testing and Materials (ASTM) specifications:

ASTM A252

Scope

"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."

Material & Manufacture

"The piles shall be made by the seamless, electric resistance weld, flash weld, or fusion welded process. The seams of welded pipe piles shall be longitudinal, helical-butt, or helical-lap."

ASTM A572

Scope

"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."

ASTM A690

Scope

"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 A139

Scope

"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."

ASTM A1011

Scope

"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."

ASTM A1018

Scope

"This specification covers hot-rolled, heavy-thickness coils beyond the size limits of Specification A1011/A1011M."

AWWA C200*

Scope

"This standard describes electrically butt-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: ASTM International

* Source: American Water Works Association (AWWA)

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 spiralweld and rolled and welded 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. The Tappan Zee Bridge in New York used tens of thousands of tons of 72 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 being placed. The ability to inspect the bottom 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.

Sign Poles, Towers, & Transmission Lines

Sign poles and towers have 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 easy 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.

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 (rx and ry) for the X and Y axes, while it is constant for a pipe. The end result is that a pipe can take much higher loads for long unsupported members.

Sample: 40 foot axially loaded section

Section	ry(in)	Weight (lbs/ft)	Buckling Load (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.

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 is there to transfer the pressures to the pipe. 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 so the offset of the neutral axis due to the sheet pile is not taken into account.

$$\text{Inertia}_{\text{system}} = (\text{Inertia}_{\text{pipe}} + \text{Inertia}_{\text{sheetpile}}) / (\text{System Width})$$

$$\text{Modulus}_{\text{system}} = \text{Inertia}_{\text{system}} / \text{Radius}_{\text{pipe}}$$

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.

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 pre-prepared for splicing. Bracing rings are used to keep the pipe thicknesses to a minimum.

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 a very effective way to transfer liquids and air. Steel Pipe is pound per pound stronger than any other type of pipe. Pipe can be designed to handle both internal and external pressures of most applications. Welded steel pipe offers many advantages, such as: strength, economy, lightweight and ease of installation. Nucor Skyline is SPFA certified and manufactures hydrotested pipe for a variety of applications. We produce 10 3/4" OD - 90" OD hydrotested pipe using a Double Submerged Arc Weld process in both Spiralweld and Rolled & Welded Pipe. Hydrotested pipe lengths range from 30’-60’, wall thickness from .250" - 2.0" wall and produced per AWWA C200/ ASTM A139/ASTM A134.

Abrasion Resistant Pipe

Nucor Skyline can make pipe from abrasion resistant steel. This pipe is excellent for transporting high solid slurry mixtures. Some examples of this are pipe being used to move dredge material and mine tailings. The hardness of the abrasion resistant steel increases the longevity of the steel.

Specialty Fabrication Services

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

- Belled Ends for Slip Joints
- Custom Fabrication (Upon Request)
- Cutting/Splicing to Custom Lengths
- Cutting Shoes
- Elbows
- End Plate/Point Attachments
- Flanges
- Laterals & Reducers
- Lifting Lugs
- Reinforcing Bands
- Splicing or Splicers
- Wyes
- Sheet Pile Interlock Attachment

C9 Connector Attachment

Rock Crushers

Pipe with Slots

Custom Fabrication: Oscillator Casing

Custom Fabrication: Oscillator Casing

Custom Fabrication

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) and audited by Lloyd's Registry Quality Assurance. Additionally, each plant is staffed with Certified Weld Inspectors to assure a quality weld in every pipe.

<u>Services Available</u>

- Non-Destructive Testing (NDT)
  - Hydrostatic Testing
  - In-line and Handheld UT Testing
  - Magnetic Particle
  - CWI Inspection
- Material Test Reports (MTR)
- Weld Quality Control Plan (WQCP)

Qualifications

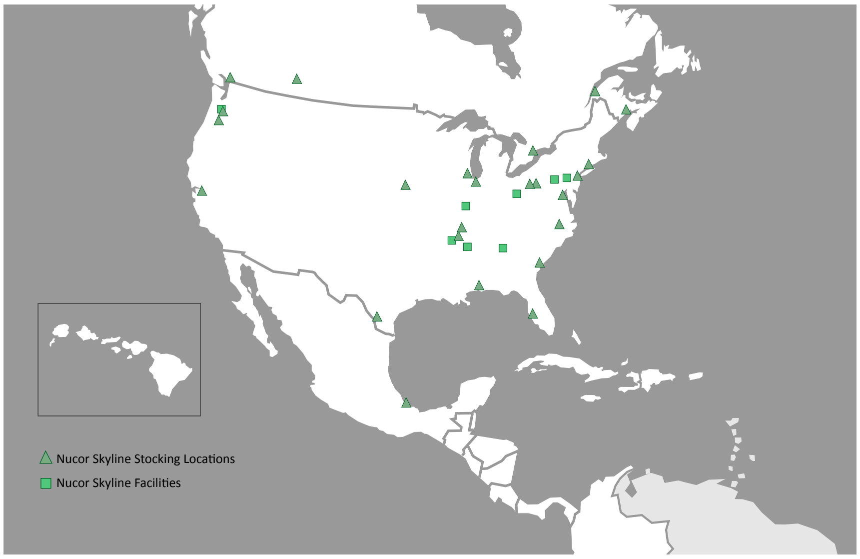
- American Welding Society (AWS)
- American Society of Mechanical Engineers (ASME)
- Pre-qualified
- AWS Section 3
- Qualified by Test
- AWS Section 4 / ASME Section IX
- AWS Section 4 WPS – Weld Procedure Specification
- AWS Section 4 PQR -Procedure Qualification Test Record
- Weld Quality Control Plan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

Quality Assurance

- Non-destructive Testing (NDT)
- Visual Inspection (VI)
- Ultrasonic Testing (UT)
- Radiographic Testing / X-ray (RT)
- Magnetic Particle Testing (Mag. Testing)
- Dye Penetration Testing
- Macro Etch Testing
- Hydrostatic 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 ready to serve you with delivery via truck, rail, or barge.



Rolled & Welded Pipe

Manufacturing Process

Rolled & Welded Pipe is the primary manufacturing process for steel thicknesses that exceed spiral mill capabilities (greater than 1”).

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 the cylinder it will be rolled into.

BEVELING
After the plate is cut, it is transferred to the beveling station where different bevel angles are cut into the plate edge 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, using a tandem wire submerged arc welding process.

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

CIRCUMFERENTIAL WELDING
During this last step of the manufacturing process, cans are fit together and the pipe is manufactured using the submerged arc process, according to customer requirements for specific lengths.

FINISHED PIPE
The finished pipe, produced according to the customer’s specifications, is then removed and ready for delivery.

Spiralweld Pipe

Manufacturing Process

The **spiralweld** manufacturing process is one of the most cost effective ways to produce steel pipe. The mill setup offers a varying degree of flexibility, allowing for a wide range of pipe diameters and wall thicknesses to be produced. As a result, Nucor Skyline is able to offer spiralweld products to many structural and non-structural markets at the most economical cost.

Spiralweld Pipe is manufactured from steel coil.

UNCOILING
Upon receipt of the coil, it is placed on a horizontal uncoiler 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.

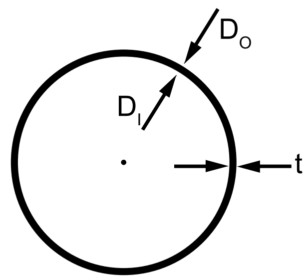
JOINING OF THE COIL ENDS
As the coil continues to move through the straightener, the leading and trailing edges of the strip are trimmed in preparation for butt welding – coil to coil.

EDGE MILLING
The edges of the coil are trimmed in preparation 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.

SINGLE & TANDEM PIPE WELDING
The welding system welds the pipe, both inside and outside, using a submerged arc welding system.

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.



APPROXIMATE VALUES

Pipe Weight (lbs/ft) = $10.69*t*(D_o-t)$
D_o (in) - outside diameter
t (in) - thickness of pipe

Pipe Weight (kg/m) = $0.0247*t*(D_o-t)$
D_o (mm) - outside diameter
t (mm) - thickness of pipe

PIPE WEIGHT lbs/ft (kg/m)

Outside Diameter (D_o)	Wall Thickness (t) in (mm)													
in (mm)	0.250 6.35	0.312 7.92	0.375 9.52	0.438 11.13	0.500 12.70	0.562 14.27	0.625 15.87	0.688 17.48	0.750 19.05	0.875 22.22	1.000 25.40	1.250 31.75	1.375 34.92	1.50 - 2.25 38.10 - 57.15
24 609.6	63.47 94.45	79.01 117.58	94.71 140.94	110.32 164.17	125.61 186.93	141.05 209.91	156.17 232.41	171.45 255.15	186.41 277.41					
30 762.0	79.51 118.32	99.02 147.36	118.76 176.73	138.42 205.99	157.68 234.65	176.86 263.20	196.26 292.07	215.58 320.82	234.51 348.99	272.43 405.42	310.01 461.35			
36 914.4	95.54 142.18	119.03 177.14	142.81 212.53	166.51 247.79	189.75 282.38	212.90 316.83	236.35 351.73	259.71 386.49	282.62 420.59	328.55 488.94	374.15 556.80	464.35 691.03		
42 1067	111.58 166.05	139.04 206.91	166.86 248.32	194.60 289.60	221.82 330.11	248.95 370.48	276.44 411.39	303.84 452.16	330.72 492.17	384.67 572.45	438.29 652.25	544.52 810.34	597.14 888.64	
48 1219	127.61 189.90	159.05 236.69	190.92 284.12	222.70 331.41	253.89 377.83	285.00 424.13	316.52 471.03	347.97 517.84	378.83 563.76	440.80 655.98	502.43 747.70	624.70 929.66	685.33 1019.89	Max. wall thickness of 1.50" (38.1mm). Please call for weight.
54 1372	143.65 213.78	179.06 266.47	214.97 319.91	250.79 373.22	285.96 425.56	321.04 477.76	356.61 530.70	392.09 583.50	426.93 635.34	496.92 739.50	566.57 843.15	704.87 1048.96	773.52 1151.13	
60 1524	159.68 237.63	199.08 296.26	239.02 355.70	278.88 415.02	318.03 473.28	357.09 531.41	396.70 590.36	436.22 649.17	475.04 706.94	553.04 823.02	630.71 938.60	785.05 1168.29	861.71 1282.37	Max. wall thickness of 1.625" (41.3mm). Please call for weight.
66 1676	175.72 261.50	219.09 326.04	263.07 391.49	306.98 456.84	350.10 521.01	393.14 585.06	436.79 650.02	480.35 714.84	523.14 778.52	609.16 906.53	694.85 1034.05	865.22 1287.59	949.91 1413.62	
72 1829	191.75 285.36	239.10 355.82	287.13 427.30	335.07 498.64	382.17 568.73	429.18 638.69	476.87 709.66	524.48 780.51	571.25 850.12	665.29 990.06	758.99 1129.50	945.40 1406.91	1038.10 1544.87	
78 1981	207.79 309.23	259.11 385.60	311.18 463.09	363.16 540.44	414.24 616.46	465.23 692.34	516.96 769.32	568.61 846.19	619.35 921.70	721.41 1073.58	823.13 1224.95	1025.57 1526.22	1126.29 1676.11	Max. wall thickness of 1.75" (44.4mm). Please call for weight.
84 2134	223.82 333.08	279.12 415.38	335.23 498.88	391.26 582.26	446.31 664.18	501.28 745.99	557.05 828.98	612.74 911.86	667.46 993.29	777.53 1157.09	887.27 1320.41	1105.75 1645.54	1214.48 1807.35	
90 2286	239.86 356.95	299.13 445.16	359.28 534.67	419.35 624.06	478.38 711.91	537.32 799.62	597.14 888.64	656.86 977.52	715.56 1064.87	833.65 1240.61	951.41 1415.86	1185.92 1764.85	1302.68 1938.61	
96 2438	255.89 380.81	319.15 474.95	383.34 570.47	447.44 665.87	510.45 759.63	573.37 853.27	637.22 948.29	700.99 1043.19	763.67 1136.47	889.78 1324.14	1015.55 1511.31	1266.10 1884.17	1390.87 2069.85	
102 2591	271.93 404.68	339.16 504.73	407.39 606.26	475.54 707.68	542.52 807.36	609.42 906.92	677.31 1007.95	745.12 1108.86	811.77 1208.05	945.90 1407.66	1079.69 1606.76	1346.27 2003.47	1479.06 2201.09	Max. wall thickness of 2.00" (50.8mm). Please call for weight.
108 2743	287.96 428.53	359.17 534.50	431.44 642.05	503.63 749.49	574.59 855.09	645.46 960.55	717.40 1067.61	789.25 1174.54	859.88 1279.65	1002.02 1491.17	1143.83 1702.21	1426.45 2122.80	1567.25 2332.33	
114 2896	304.00 452.40	379.18 564.28	455.49 677.85	531.72 791.29	606.66 902.81	681.51 1014.20	757.49 1127.27	833.38 1240.21	907.98 1351.23	1210.48 1801.40	1207.97 1797.66	1506.62 2242.10	1655.45 2463.59	
120 3048	320.03 476.26	399.19 594.06	479.55 713.65	559.82 833.11	638.73 950.54	717.56 1067.85	797.57 1186.92	877.51 1305.88	956.09 1422.82	1274.62 1896.85	1272.11 1893.11	1586.80 2361.42	1743.64 2594.83	
126 3200		419.20 623.84	503.60 749.44	587.91 874.91	670.80 998.26	753.60 1121.48	837.66 1246.58	921.63 1371.54	1004.19 1494.40	1338.76 1992.30	1336.25 1988.56	1666.97 2480.73	1831.83 2726.07	
132 3353		439.22 653.63	527.65 785.23	616.00 916.71	702.87 1045.99	789.65 1175.13	877.75 1306.24	965.76 1437.21	1052.30 1566.00	1402.90 2087.75	1400.39 2084.01	1747.15 2600.05	1920.02 2857.31	
138 3505			551.70 821.02	644.10 958.53	734.94 1093.71	825.70 1228.78	917.84 1365.90	1009.89 1502.88	1100.40 1637.58	1467.07 2183.25	1464.53 2179.47	1827.32 2719.36	2008.22 2988.57	
144 3657.6			575.76 856.83	672.19 1000.33	767.01 1141.44	861.74 1282.41	957.92 1425.54	1054.02 1568.56	1148.51 1709.17	1531.18 2278.65	1528.67 2274.92	1907.50 2838.68	2096.41 3119.81	Max. wall thickness of 2.25" (57.1mm). Please call for weight.
150 3810			599.81 892.62	700.28 1042.13	799.08 1189.16	897.79 1336.06	998.01 1485.21	1098.15 1634.23	1196.61 1780.76	1595.32 2374.10	1592.81 2370.37	1987.67 2957.98	2184.60 3251.05	
156 3962			623.86 928.41	728.38 1083.95	831.15 1236.89	933.84 1389.71	1038.10 1544.87	1142.28 1699.90	1244.72 1852.35	1659.46 2469.55	1656.95 2465.82	2067.85 3077.31	2272.79 3382.29	
162 4115				756.47 1125.75	863.22 1284.62	969.88 1443.34	1078.19 1604.53	1186.40 1765.56	1292.82 1923.93	1723.82 2565.33	1721.09 2561.27	2148.02 3196.61	2360.99 3513.55	
168 4267				784.56 1167.56	895.29 1332.34	1005.93 1496.99	1118.27 1664.17	1230.53 1831.23	1340.93 1995.53	1787.74 2660.46	1785.23 2656.72	2228.20 3315.93	2449.18 3644.79	
169-204 4293 - 5182	Please call for weight.													

Available Pipe Grades					
ASTM	YIELD STRENGTH		ASTM	YIELD STRENGTH	
	(ksi)	(MPa)		(ksi)	(MPa)
A134			A 252 Grade 1	30	205
A 139 Grade A	30	205	A 252 Grade 2	35	240
A 139 Grade B	35	240	A 252 Grade 3	45	310
A 139 Grade C	42	290	A 252 Grade 3 (Mod)*	50-80	345-555
A 139 Grade D	46	315	AWWA C200		
A 139 Grade E	52	360			

*Availability is dependent on pipe diameter and thickness.

Available Steel Specifications
ASTM
A 36
A 516 Grade 55-70
A 572 Grade 50-65
A 588

Additional Capabilities

Installation of:
Bands, Cutting Shoes, End Plates, Carbide Teeth, Rolled Channel and Angle Iron, Twisting Slots, Picking Eyes, Lifting Lugs, etc.

Fabrication of Segmented Fittings:
Elbows, Wyes, Laterals, Tees, Concentric and Eccentric Reducers.

Manufacturers of concentric tapered pipe from .250" to 2" wall thickness.

Pipe manufactured to American Welding Society. Structural welding code AWS D1.1 or D1.5 is also available.

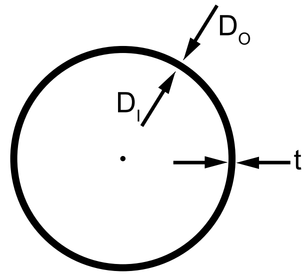
Delivery Conditions & Tolerances

	ASTM
Outside Diameter	± 1%
Weight/Thickness	Per Specification
Length	± 1 inch

Maximum Rolled Lengths*

Rolled & Welded	120 feet	(36.6 m)

* Longer lengths may be possible upon request.



PIPE WEIGHT lbs/ft (kg/m)											
Outside Diameter (D_o) in (mm)	**WALL THICKNESS (t)** in (mm)										
	0.179 4.55	0.188 4.78	0.203 5.16	0.219 5.56	0.250 6.35	0.312 7.92	0.375 9.53	0.500 12.70	0.625 15.88	0.750 19.05	1.000 25.40
8.625 219.1	16.16 24.05	16.96 25.23	18.28 27.20	19.68 29.29	22.38 33.31						
10 254.0	18.79 27.97	19.72 29.35	21.26 31.64	22.90 34.08	26.06 38.78						
10.75 273.1	20.23 30.10	21.23 31.59	22.89 34.06	24.65 36.69	28.06 41.76	34.81 51.81	40.52 (0.365) 60.30				
12 304.8	22.62 33.66	23.74 35.33	25.60 38.10	27.58 41.04	31.40 46.73	38.98 58.01	46.60 69.35				
12.75 323.9	24.05 35.80	25.25 37.57	27.23 40.52	29.34 43.66	33.41 49.71	41.48 61.74	49.61 73.83				
14 355.6	26.45 39.36	27.76 41.31	29.94 44.56	32.26 48.01	36.75 54.69	45.65 67.94	54.62 81.28	72.16 107.38			
16 406.4	30.27 45.05	31.78 47.29	34.28 51.02	36.95 54.98	42.09 62.64	52.32 77.87	62.64 93.21	82.85 123.29			
18 457.2	34.10 50.75	35.80 53.27	38.62 57.47	41.63 61.95	47.44 70.59	58.99 87.79	70.65 105.15	93.54 139.20			
20 508.0	37.93 56.44	39.82 59.25	42.96 63.93	46.31 68.92	52.78 78.55	65.66 97.72	78.67 117.08	104.23 155.11	129.45 192.64		
24 609.6	45.58 67.83	47.86 71.22	51.64 76.85	55.67 82.85	63.47 94.46	79.01 117.57	94.71 140.94	125.61 186.92	156.17 232.41	186.41 277.40	
30 762.0					79.51 118.32	99.02 147.36	118.76 176.73	157.68 234.65	196.26 292.07	234.51 348.99	310.01 461.35
36 914.4					95.54 142.18	119.03 177.14	142.81 212.53	189.75 282.38	236.35 351.73	282.62 420.58	374.15 556.80
42 1067					111.58 116.05	139.04 206.92	166.86 248.32	221.82 330.10	276.44 411.38	330.72 492.17	438.29 652.25
48 1219					127.61 189.91	159.05 236.70	190.92 284.12	253.89 377.83	316.52 471.04	378.83 563.76	502.43 747.70
54 1372							214.97 319.91	285.96 425.55	356.61 530.70	426.93 635.35	566.57 843.15
60 1524							239.02 355.70	318.03 473.28	396.70 590.35	475.04 706.93	630.71 938.60
72 1829							287.13 427.29	382.17 568.73	476.87 709.67	571.25 850.11	758.99 1129.50
84 2134							335.23 498.88	446.31 664.18	557.05 828.98	667.46 993.29	887.27 1320.41
96 2438								510.45 759.63	637.22 948.30	763.67 1136.46	1015.55 1511.31
108 2743								574.59 855.08	717.40 1067.61	859.88 1279.64	1143.83 1702.21
120 3048								638.73 950.53	797.57 1186.92	958.09 1422.82	1272.11 1893.11

Please inquire about other diameters and thicknesses.

APPROXIMATE VALUES

Pipe Weight (lbs/ft) = 10.69*t*(d-t)
d (in) - outside diameter
t (in) - thickness of pipe

Pipe Weight (kg/m) = 0.0247*t*(d-t)
d (mm) - outside diameter
t (mm) - thickness of pipe

Spiralweld Pipe

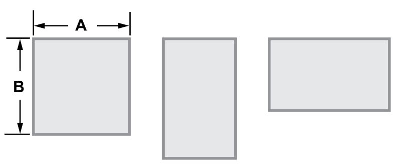
Available Pipe Grades					
ASTM	YIELD STRENGTH		ASTM	YIELD STRENGTH	
	(ksi)	(MPa)		(ksi)	(MPa)
A 139 Grade A	30	205	A 252 Grade 1	30	205
A 139 Grade B	35	240	A 252 Grade 2	35	240
A 139 Grade C	42	290	A 252 Grade 3	45	310
A 139 Grade D	46	315	A 252 Grade 3 (Mod)*	50-80	345-555
A 139 Grade E	52	360	AWWA C200		

*Availability is dependent on pipe diameter and thickness.

Available Steel Specifications
ASTM
A 588
A 690
A 572
A 709
A 1011
A 1018
Abrasion Resistant

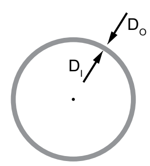
Easy Weight Calculator (All Dimensions in inches. Density of steel = 0.2836 lbs/in^3)

Rectangles and Squares



Weight (lbs) = **A** x **B** x **Thickness** x **0.2836**

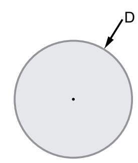
Rings



Weight (lbs) = **Thickness** x $\frac{\pi}{4}(D_O^2 - D_I^2)$ x **0.2836**

Area = $\frac{\pi}{4}(D_O^2 - D_I^2)$

Circular Plates



Weight (lbs) = **Thickness** x $\frac{\pi}{4}(D^2)$ x **0.2836**

Area = $\frac{\pi}{4}D^2$

Delivery Conditions & Tolerances**

	ASTM
Pipe Piles:	
Outside Diameter	± 1%
Weight/Thickness	– 5%
Length	± 1 inch

**Tighter specifications may be possible upon request.

Maximum Rolled Lengths***

Spiralweld	130 feet	(39.6 m)

*** Longer lengths may be possible upon request.

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. Without oxygen or extremely acidic soil the steel will not corrode.

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 water.

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

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.

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About Nucor Skyline
A premier steel foundation supplier serving the U.S., Canada, Mexico, the Caribbean, Central America, and Colombia, Skyline Steel, LLC is a wholly-owned subsidiary of Nucor Corporation, the largest producer of steel in the United States.

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