



An Introduction into the **Production and Specification of Steel Pipe**

By Bill Buckland, President, Mandal Pipe Company

To understand the production of steel pipe, we must start at the beginning of basic steel production. Most steel products are downstream, value added products made from these four basic or primary forms of raw steel: ingots, billets, blooms and slabs. These forms can be produced in great volumes and are easily re-heated, extruded, squeezed or formed into many other configurations so as to make virtually every steel product used today.

Steel pipe is produced from two of these basic forms of steel, the round billet and the slab. A billet is a solid round bar of steel used to produce many other downstream products such as seamless pipe. The other types of steel pipe are produced from slabs, which are solid rectangular blocks of steel. The slabs are reheated and processed into plate and coils.

There are four methods used to produce steel pipe: Fusion Weld, Electric Resistance Weld, Seamless and Double Submerged Arc Weld.

Fusion Weld

One process for producing pipe is Fusion Weld, sometimes called "Continuous Weld" and is produced in sizes 1/8" to 4-1/2". Fusion Weld pipe begins as coiled steel of the required width and thickness for the size and weight of pipe to be made. Successive coils of steel are welded end to end to form a continuous ribbon of steel. The ribbon of steel is fed into a leveler and then into a gas furnace where it is heated to the required temperature for forming and fusing. The forming rolls at the end of the furnace shape the heated skelp into an oval.

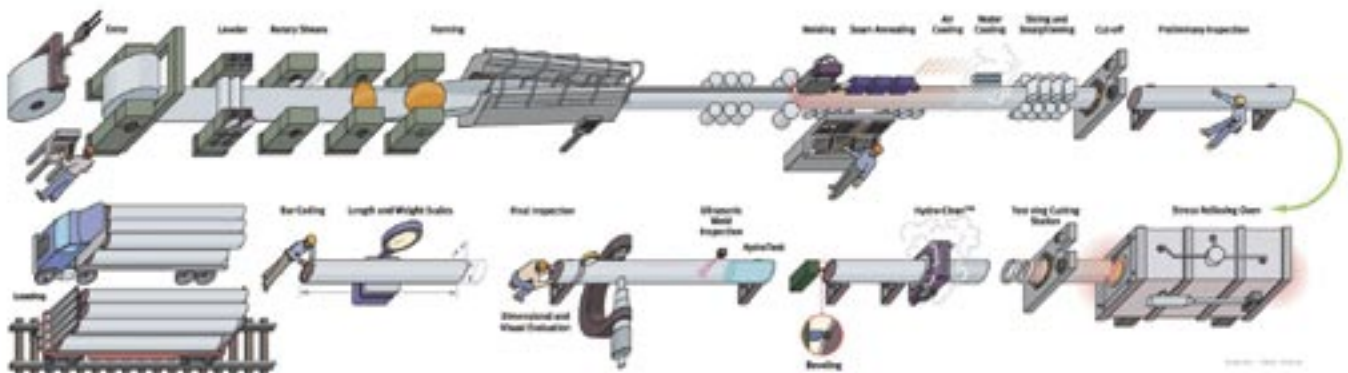
The edges of the skelp are then firmly pressed together by rolls to obtain a forged weld. The heat of the skelp, combined with the pressure exerted by the rolls, form the weld. No metal is added into the operation. Final sizing rolls bring the pipe into its required dimensions.

Seamless Pipe (SMLS)

Seamless Pipe is made when steel in a solid, round cylindrical shape, called a "billet" or a "tube round" is heated and then either pushed or pulled (while being rapidly rotated) over a mandrel with a piercing point positioned in the center of the billet. This activity produces a hollow tube or "shell". The tube is then further finished until it becomes the size and wall thickness desired. (Because the pipe is formed in a heated manner the pipe is normalized and should have a consistent steel cellular pattern throughout its circumference). Seamless pipe is made in sizes from 1/8" to 26" and is widely used in construction, oil refining, chemical and petro-chemical industries. It is available in heavy wall thicknesses and exotic chemistries, and is suitable for coiling, flanging and threading. It is, however, expensive, in short supply and unavailable in long lengths.

Electric Resistance Weld

The processing of Electric Resistance Welded (ERW) pipe begins as a coiled plate of steel with appropriate thickness and specific width to form a pipe that conforms to its relevant specification. ERW pipe is cold formed. The ribbon is pulled



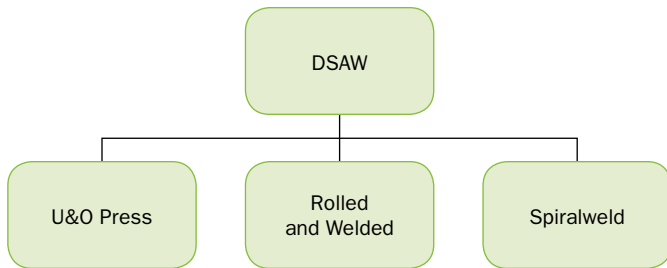
through a series of rollers that gradually form it into a cylindrical tube. As the edges of the now cylindrical plate come together, an electric charge is applied at the proper points to heat the edges so they can be welded together.

Electric Resistance Welded pipe is a high speed production product that can be made in continuous lengths up to 115'. It produces uniform wall thicknesses and outside dimensions and is made in a wide range of specifications. It does, however, require minimum tonnage to set up on a specific size and sometimes has long lead times.

Double Submerged Arc Weld (DSAW)

Submerged Arc Welded (SAW) pipe derives its name from the process wherein the welding arc is submerged in flux while the welding takes place. The flux protects the steel in the weld area from any impurities in the air when heated to welding temperatures. When both inside welds and outside welds are performed, the welding is accomplished in separate processes and the pipe is considered to be Double Submerged Arc Welded (DSAW).

There are three common types of pipe produced by the DSAW process.



U&O Method

The U&O Method is so called because it first uses a “U” press, then an “O” press to complete cylinder forming from 40’ long plates ordered to size and grade. The cylinder is then welded inside and outside by the submerged arc process by using as many as five welding wires. Most U&O is cold expanded either mechanically or hydraulically. When it is cold expanded, DSAW pipe gains in yield strength. This method of pipe production produces exceptional quality with exact dimensional tolerances. The primary use of this type of pipe is gas and oil transmission. It requires large minimum tonnages for size setup and is only produced domestically in 40-foot lengths.

Rolled and Welded

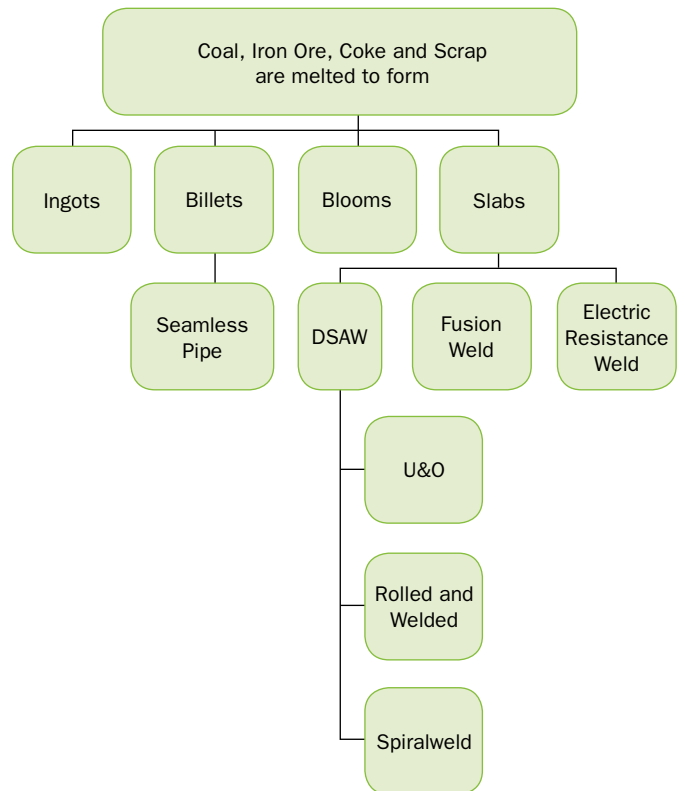
This method of manufacturing is also called the “Pyramid Roll Method” because it uses three rolls arranged in a pyramidal structure. The plate, ordered by grade and thickness, is rolled back and forth between the pyramid rolls until the cylinder is formed. The cylinder is then moved to the welding stations. Most pyramid rolls are 20 feet in length or shorter. Greater lengths are achieved by girth welding the five-foot, 10-foot or 20-foot sections (or cans) together. Berg Steel is the only producer capable of rolling 40-foot plates without a mid-weld and it is the only producer capable of sizing its product. Rolled and welded pipe has the advantage of being rolled in small quantities with short lead times. It can be produced in very large diameters, either ID or OD, and in extremely thick

walls. Since the cans are short in length, the production of composite piles or pieces varying in yield and tensile are easily attained. The rate of production of this material is slow and the cost is high due to multiple girth welds.

Spiral Weld

Spiralweld pipe is a steel pipe having a DSAW seam the entire length of the pipe in a spiral form. The outside diameter is determined by the angle of the de-coiled steel against the forming head. The more acute the angle, the greater the diameter. The production of large, hot rolled coils of sufficient width and the development of dependable non-destructive testing methods has enabled this product to be placed in more demanding service. Spiralweld pipe can be rolled in exact lengths up to 115 feet in either ID or OD dimensions up to 144 inches. There is a minimum tonnage required for rolling. Because the manufacturing process is slow, it gives the contractor an advantage of short term changes to the order. This same slow production can also be a disadvantage when large tonnages are needed with a short lead time. Spiralweld pipe is produced to limited specifications.

Now, if this is confusing to you, don’t get discouraged. Steel pipe is a complex world to understand. A few charts might help.



The piling industry uses virtually no Fusion Weld pipe as it is produced in small sizes and is used mostly for plumbing, handrails and fencing. DSAW pipe and ERW pipe are used extensively and to a lesser extent seamless pipe. To illustrate the speed with which each method of production is capable, the following chart will be illustrative. We use the 24” diameter pipe because it is the only size common to all the forms of production.

**Manufacturing Output Using
24" OD x .500 Wall Per Eight Hour Shift**

ERW	SMLS	U&O Press	Spiralweld	Rolled & Welded
1000 Tons or 16000'	350 Tons or 6000'	250 Tons or 4000'	50 Tons or 800'	10 Tons or 160'

There are hundreds of specifications governing the production and use of steel pipe. The following chart will examine just a few of the common specifications you will normally see in the piling industry.

Pipe Specifications

Grade	Domestic Size Range	Usage
ASTM A-53	1/8" thru 26"	Domestic and plumbing piping under normal pressures and temperatures
ASTM A-106	1/8" thru 26"	Seamless pipe for high temperatures and pressures
ASTM A-139	4" and larger	Industrial piping, mainly water
ASTM A-252	Any size	Pipe piling, drilled shafts and other structural applications
ASTM A-500	Maximum 64" OD	Structural applications for welding, riveting or bolted construction
API 5 L	1/8" thru 48"	Oil and natural gas transmission
API 2 B	54" and larger	Rolled and welded for oil and gas offshore platform construction
AWWA C-200	6" and larger	Water and waste water piping

These specifications vary by their production methods.

Methods of Manufacture-Pipe Specifications

Grade	FW	ERW	SMLS	U&O	SPIRAL	R&W
Domestic size range	1/8"-4"	2"-24"	1/8"-26"	20"-48"	4"-144"	20"-144"
ASTM A-53	Yes	Yes	Yes	No	No	No
ASTM A-106	No	No	Yes	No	No	No
ASTM A-139	No	No	No	Yes	Yes	Yes
ASTM A-252	No	Yes	Yes	Yes	Yes	Yes
ASTM A-500	No	Yes	Yes	No	No	No
API 5 L	Yes	Yes	Yes	Yes	Yes	Yes
AWWA C200	No	Yes	Yes	Yes	Yes	Yes

George G. Goble Consulting Engineers, LLC

George G. Goble
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Digest of Common Specifications				
	A-53	A-500	A-252	API 5L
Type	Type E Type S	Seamless Welded	Seamless ERW, DSAW	Seamless ERW, DSAW
Grades	A B	None	1,2,3	X-42, X-52, X-56, X-60, X-65
Chemistry	% Max C, MN, P, S	% Max of C, P, S	0.05 Max % Phos	C, MN, S, CB, V
Yield	A=30,000 B=35,000	36,000	1=30,000 2=35,000 3=46,000	X-42=42,000 X-52=52,000 X-60=60,000
Tensile	A=48,000 Min PSI B=60,000 Min PSI	58,000	1=50,000 2=60,000 3=66,000	X-42=60,000 X-52=66,000 X-60=75,000
Hydro	Yes	None	None	Yes
Wall Tolerance	Minimum wall not more than 12.5% under nom	+/- 10% of nominal wall thickness	Minimum wall not more than 12.5% under nom	+15%, -12.5%
OD Tolerance	+/- 1% of OD	+/- .75% of OD	+/-1% of OD	+/- .75% of OD
Weight Tolerance	=/- 10% of theoretical weight	None	Not more than 12.5% over or 5% under theoretical weight	Not more than 10% over or 3.5 % under theoretical weight

Each specification will vary slightly from the other as the only specification designed specifically for piling is ASTM A-252. The other specifications, though intended for different uses, can be used in a structural application. The differences, though subtle, may be great enough to cause problems in substitution and care must be taken to evaluate any change.

Notice that there is a weight tolerance for the ASTM A-252 pipe specification and that this tolerance is one half that of A-53. This means that the same wall thickness ordered for one specification may be thinner than that of the other. For instance, if you ordered 24 x .500 ASTM

A-53 and same amount of 24 x .500 ASTM A-252, the minimum wall thickness as addressed in the allowable variations section of the specification would be the same. However, the weight tolerance for A-53 is double that of A-252. In other words, the minimum weight allowable for 24 x .500 A-53, whose theoretical weight is 125.61#/ft, is 113.05#/ft (125.61#/ft - 12.6#/ft). But the minimum weight allowable for the 24 x .500 steel pipe under the A-252 specification is 119.33#/ft (125.61#/ft - 6.28#/ft). Put more simply, the mill is allowed to ship as low a wall thickness as .450 under the A-53 specification, but can only ship as low as .475 under the A-252 specification. But, if you followed the wall thickness tolerance only, the mill would be allowed to ship as low as .438 wall (.500 less 12.5%).

For quality control purposes, all the pertinent information about each piece of pipe can be found on the stencil affixed to that pipe. Some mills stencil on the exterior and some on the interior of the tube. Some mills are using the more modern bar codes affixed to the interior of the pipe. Most mills will stencil

Ordering Pipe	
Quantity	Feet, Tons or Pieces
Diameter	OD or ID
Wall Thickness	Standard or Special
Coating	Lacquer or Bare
Method of Manufacture	SMLS, ERW, or DSAW
Specification	ASTM, AWWA, ASME, API
Plain or Threaded	PE, Threaded
End Preparation	Bevel or Square Cut
Length	SRL, DRL, TRL, or Specified
Price	Per Foot or Per Ton
Terms	COD, Net 30, L/C, Discount
Delivery Instructions	Destination, Arrival, FOB

Example	
10,000'	24" OD X .500 Wall Bare ERW ASTM A-252 Gr. 3 Steel Pipe, PE, BEV, in 50' Lengths
Price:	\$81.50/ft.
Terms:	Net 30 Days
Delivery:	Mid March
F.O.B.:	SP/FA Charleston, SC Via Truck

When you are ready to order steel pipe, there are certain parts to the nomenclature that are required. The knowledge of these parts is beneficial to both the seller and purchaser. The more detail that can be imparted to writing, the fewer problems can occur.

additional information needed by the purchaser if instructed at the time of order entry.

There are many quality control tests available for pipe as they pertain to various industries. If you have any questions, you should ask a qualified sales representative.

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Most of these items are self explanatory. The F.O.B. point, however, is probably the most misunderstood. This item delineates the understanding between the buyer and seller as to how the material is to be delivered. The letters SP mean "Shipping Point" and the letters FA mean "Freight Allowed." It is important to understand that the seller will end his liability for insurance purposes at the shipping point with the material safely loaded to the truck; and, it is at this point that the title of ownership passes hands from the seller to the buyer. The seller will, however, "allow" the freight to the jobsite in his price. The responsibility for the material from point A to point B is for the insurance of the Truck Line. The responsibility for unloading the material is for the Contractor. If the seller were to quote the material F.O.B.: Delivered, he would then take responsibility for the material until it is unloaded to the ground, and the title would not pass to the buyer until the material is safely unloaded. In the event of an accident, the paperwork trail will be very important. Some industries will quote their products "Delivered", such as sod or wall board. Steel pipe, however, is generally quoted at the shipping point, with the freight allowed in the price. Sometimes, the contractor wants the material quoted SP/PPD-ADD. This means that the title will again pass at

the shipping point, after safely loading, but the freight will be prepaid and added to the invoice as a separate item. This designation is useful when projects require many truck or rail shipments and the freight cost is a non-taxable item. The pipe will be taxed at the appropriate rate and the freight costs will pass through untaxed. If the contractor wishes to pick up the material on his own trucks or wishes to take responsibility for the shipping, the FOB point will simply state SP (Shipping Point).

The following associations publish their specifications for all to use and it would be prudent to have the proper updated versions of their specifications in your library for reference:

Reference Material

- ASTM (American Society for Testing Material)
- API (American Petroleum Institute)
- ASME (American Society of Mechanical Engineers)
- AWWA (American Water Works Association)
- NAPCA (National Association of Steel Pipe Distributors)
- NACPA (National Association of Pipe Coating Applicators) ▼

Bill Buckland is president of Mandal Pipe Company, located in Atlanta, GA., and has been active in the steel pipe business for more than three decades. He has provided steel pipe for many high profile construction projects throughout the United States. He is currently on the board of directors of the National Association of Steel Pipe Distributors and is chairman of its Education Committee while also a member of the Education Committee for the Pile Driving Contractors Association. Direct your comments to billbuckland@mandalpipe.com.

Reading the Mill Stencil

1. Manufacture-5L – API Registration
2. Hydro pressure 3030, E = symbol for welded pipe
3. Weight/piece and length
4. F = Foreign plate then Heat #
5. SR5=Charpy 70ftLBS @ 23 degrees F
6. β (supplemental requirement)
7. Customer and purchase order #
8. Size and wall thickness
9. Piece number and grade

