



Glossary of Terms

A

AAR	Association of American Railroads
AGA	American Gas Association
Age Hardening	See Heat Treatment
Air Frame Tubing	This tubing is produced for aircraft structural parts. It is made to special surface quality, mechanical properties and other characteristics required by Military Specifications (MIL-T) and SAE Aeronautical Materials Specifications (AMS)
Aircraft Quality	Is steel which has a special cleanliness rating determined by magnetic particle testing. The terms "Aircraft Quality" and "Magnaflux Quality" are considered synonymous.
Air Testing	When air testing is performed in the tubular industry, it consists of subjecting the tube to air pressure under liquid.
AISI	American Iron & Steel Institute
Alloy	A substance that has metallic properties and is composed of two or more chemical elements of which at least one is metal.
Alloy Steel	Steel is classified as alloy when the maximum of the range given for the content of alloying elements exceeds one or more of the following: Manganese, 1.65%; Silicon, 0.060%; Copper, 0.60%; or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: Aluminum, boron, chromium up to 3.99%, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, or any other alloying element added to obtain desired alloying properties.
Alloying Elements	Chemical elements added for improving the properties of the finished products. Chief alloying elements in alloy steel are: nickel, chromium, manganese, molybdenum, vanadium, silicon or copper.
Annealing	A process involving heating and cooling, usually applied to induce softening. The term also refers to treatments intended to alter mechanical properties, produce a definite microstructure, or remove gases.

- Annealing (Bright)** A process of annealing usually carried out in a controlled furnace atmosphere so that surface oxidation is reduced to a minimum and the surface remains relatively bright.
- Annealing (Full Annealing)** Softening process in which a ferrous alloy is heated to a temperature above the transformation range and after being held for a sufficient time at this temperature, is cooled slowly to a temperature below the transformation range. The alloy is ordinarily allowed to cool slowly on the furnace, although it may be removed and cooled in some medium that insures a slow rate of cooling.
- ANSI** American National Standards Institute
- API** American Petroleum Institute
- ASM** American Society for Metals
- ASME** American Society of Mechanical Engineers
- ASTM** American Society for Testing and Materials
- As Drawn** Tubing is unheat-treated, cold drawn tubing and has a scale free cold drawn surface.
- As-Welded Cold Rolled** Used for applications where superior surface is required, as for plating. Has slightly closer wall and inside diameter tolerances in most sizes.
- As Welded Hot-Rolled** Most economical for many applications where surface finish and/or inside diameter tolerances are not as critical. May be specified with inside flash in, flash controlled to .010" max, or flash controlled to .005" max.
- Atmospheric Corrosion** Atmospheric corrosion occurs when unprotected steel is exposed to air containing moisture. The attack is generally uniform on plain surfaces and may be affected by corners or other appurtenances.
- Austenitic Grain Size** Indicates the grain structure established by a standardized heat treatment procedure.

B

- Bar Mill** Rolling mill where semi-finished billets are processed into HR bars.
- Basic Oxygen Furnace (BOF)** A steel-refining furnace used to turn molten iron, scrap and alloying elements into steel.
- Beading** Raising or depressing a ridge, of specified contour, on a section of tubing.
- Bearing Load** A compressive load is supported by a member, usually a tube or collar, along a line where contact is made with a pin, rivet, axle or shaft.

Bearing Strength	The maximum bearing load at failure divided by the effective bearing area. In a pinned or riveted joint, the effective area is calculated as the product of the diameter of the hole and the thickness of the bearing member.
Bend Radius	The radius corresponding to the curvature of a bent specimen or bent area of a formed part, measured on the inside of a bend or on the centerline of the tube, as defined.
Bend Tests	Tests used to determine the ductility and/or other characteristics of steel or tubing. The number of bends and the radius and degree of bends are generally determined by the applicable specifications.
Bevel	An angular cut on the I.D. or O.D. of a tube end. The angle formed between the prepared edge of the end of the pipe and a plane perpendicular to the surface.
Billet	A square or rectangular semi-finished form. It can be used in the manufacture of large diameter seamless tubes.
Bloom	A semi-finished piece of steel, resulting from the rolling or forging of an ingot. A bloom is square or not more than twice as thick, and usually not less than 36 sq. in. in cross-sectional area. A semi-finished hot-rolled product produced on a blooming mill.
'Blow Out'	The phrase for removing cut flash from tubing.
B.O.F.	Basic Oxygen Furnace
B.O.P.	Basic oxygen Process
Borescope	An optical device used for inspecting under low magnification the inside surface of tubes.
Box Annealing	A process of annealing a ferrous alloy in a suitable closed metal container with or without packing material in order to minimize oxidation. The charge is usually heated slowly to a temperature below the transformation range, but sometimes above or within it, and is cooled slowly. This process is also called 'close annealing' or 'pot annealing'.
Brinell Hardness	A test for determining the hardness of a material by forcing a hard steel or carbide ball of specified diameter into it under a specified load.
Brittleness	A tendency to fracture without appreciable deformation.
B.T.U.	British Thermal Unit
Burnishing	Plastic smearing such as may occur on metallic surfaces during buffing. Also used surface finishing operation on hydraulic cylinder tubing.
Burr	A rough or sharp edge left on metal by a cutting tool, i.e., slitting.

Butt-Welding	Joining two edges or ends by placing one against the other and welding or fusing the edges into a cylinder.
B.W.	Butt-Weld
B.W.G.	Birmingham Wire Gauge

C

Camber	Deviation from edge straightness usually referring to the greatest deviation of side edge from a straight line.
Carbide	A compound of carbon with one or more metallic elements.
Carbon Steel	Steel which owes its properties chiefly to various percentages of carbon without substantial amounts of other alloying elements; also known as straight carbon steel, or plain carbon steel. Steel is classified as carbon steel when no minimum content of elements other than carbon is specified or required to obtain a desired alloying effect; when the specified minimum for copper does not exceed 0.20%, or the maximum content for the following does not exceed the percentages noted: manganese, 1.65%, silicon, 0.60%, copper, 0.60%.
Carburizing	To introduce carbon; <ul style="list-style-type: none"> 0. While steel is molten by adding carbonaceous material, coke, coal, electrode scrap, etc. 1. While steel is in the solid state by heating it in contact with carbonaceous matter.
Case-Hardening	A process of hardening a ferrous alloy so that the surface layer or case is made substantially harder than the interior core. Typical case-hardening processes are carburizing and quenching, cyaniding, carbonitriding, nitriding, induction hardening and flame hardening.
Centerless Grinding	is a method of grinding un-mounted cylindrical surfaces.
Chamfer	to cut at an angle or bevel. A beveled surface to eliminate an otherwise sharp corner. A finishing operation prior to treading.
Charpy Impact Testing	See Impact Testing
Chemical Properties	Normally associated with a limited number of chemical elements. Minimum or maximum limits are established in most ASTM and SAE specifications.
Chromium	An alloying element added to alloy steel (in amounts up to 1.50%) to increase hardenability. Chromium content of 5% or more confers special ability to resist corrosion. Steels containing more than 10.5% chromium are called "Stainless Steels".
Clean-up	The amount of metal removal required obtaining desired dimensions and complete removal of inherent surface imperfections.

Clean Up Allowance Must be added to the finished O.D. dimension or subtracted from the finished I.D. dimension to provide for the elimination of surface imperfections.

Coating The process of covering steel with another material, primarily for corrosion resistance.

Coatings...Types of Due to various customer preferences and methods of storage before use, many pressure or mechanical tubing specifications do not indicate the type of protective coating for tube orders. Many types of proprietary coatings are available, but individual producers usually have a standard type most suitable to their major customers.

The following definitions are commonly accepted and practiced in the industry.

DRY

Indicate absolutely no oil coating. Since these tubes have no protective coating, they are susceptible to rapid rusting during transit and storage.

NO OIL

There is no intentional application of oil. A light coating of oil in the tubes gives limited protection against rust.

LIGHT PETROLEUM OIL

Tubes dipped or sprayed. The oil never dries and tubes remain oily throughout storage. Normal cleaning methods will remove the oil.

WATER SOLUBLE OIL

This leaves a light oil or waxy film on the tubes. Normal cleaning methods will remove the oil or film.

Coefficient of Thermal Expansion A physical property value representing the change in length per unit length, the change in area per unit area or the change in volume per unit volume per one degree increases in temperature.

Cold Drawing The process of pulling a tube through a hardened steel or carbide die to reduce its inside diameter and obtain closer O.D. tolerances. Process can also be carried out by pulling the tube over a mandrel as it progresses through a die, thereby more closely controlling the inside diameter. Higher tensile and yield properties are obtained because the operation is performed at room temperature or in isolated cases at elevated temperatures, but considerably under the lower critical temperature.

Cold Draw	Refers to tubing drawn in the cold state through a hardened steel or carbide die, either with or without a mandrel on the inside.
Cold Reduction	The reduction of sectional dimensions of a tube by any of a number of types of cold-working operations.
Cold Rolled Sheet	Hot rolled sheet cold reduced to obtain tighter gauges and better surface finish than hot rolled sheet products.
Cold Work	Plastic deformation at such temperatures and rates that substantial increases occur in the strength and hardness of the shape and, in some cases, mechanical twinning or banding.
Cold Working	Deforming a metal plastically at such temperature and rate that strain hardening occurs. The upper limit of temperature for this process is the recrystallization temperature.
Columbium	A metal which is added to steels to increase their strength after hot rolling through precipitation of carbides. One of several typical additives for high strength-low alloy or micro-alloyed steel.
Commercial Quality (CQ)	Sheet of this quality is for uses involving simple bending or moderate drawing. Commercial Quality sheet can be bent flat upon itself in any direction at room temperature.
Commercial Quality Tubing	A term used to describe tubing that may be used as it's received for many applications. It is generally produced to the supplier's wall thicknesses, O.D. and I.D. tolerances, as well as to the supplier's mechanical properties.
Compression Test (Tubing)	Test made on a section of a tube applying compressive force perpendicular to the diameter of the tube. Also called Crush Test.
Con Cast	Trade name for continuous cast.
Concentricity	The relationship between the center of the inside diameter and the center of the outside diameter. Concentricity is related to the variation in the wall thickness of any one circumference of a tube.
Conditioning	The removal of surface defects (seams, laps, pits, etc) from steel. Conditioning is usually done when the steel is in the semi-finished condition (bloom, billet, slab). It may be accomplished, after inspection, by scarfing, grinding or machining.
Continuous Casting	A casting technique in which a slab or billet, or other shape is continuously solidified while it is being poured, so that its length is not determined by mold dimensions.
Continuous Weld (C.W.)	In contrast to the ERW system, the steel is formed into a tubular shape while the steel is hot. The edges when they meet are fused or welded together, but no additional weld material is necessary. (For C.W. tubing, the tube is always further processed by cold drawing.)

Continuous Butt-weld (CBW)	See Continuous Weld
Controlled Cooling	A process from an elevated temperature in a predetermined manner, to avoid hardening, cracking or internal damage, or to produce a desired microstructure. This cooling usually follows the final hot forming operations.
Cooling Stresses	Stresses developed by uneven contraction of external constraint of metal during cooling; also those stresses resulting from localized plastic deformation during cooling and retained.
Corrosion	Gradual chemical or electrochemical attack on a metal by atmosphere, moisture or other agents.
Corrosion Fatigue	The repeated cyclical stressing of a metal in a corrosive medium, resulting in more rapid deterioration of properties than would be encountered as a result of either cyclic stressing or of corrosion alone.
Creep	The long-term deformation of metals under a constant load or a constant stress, usually at elevated temperatures. Loading times are generally in excess of 100,000 hours.
Creep Strength	The constant nominal stress that will cause a specified quantity of creep in a given time at a constant temperature. It is a measure of a tube's ability to withstand prolonged stress or load without significant continuous deformation. In steels, it is an important factor only at elevated temperatures.
Critical Strain	The percentage strain or amount of cold work at which large grain growth occurs during annealing at a specific temperature.
Crop	The end or ends of an ingot that contain the pipe or the other defects to be cut off and discarded; also termed "crop end" and "discard".
Crown	Crown, in plates, sheet or strips, is characterized by a greater thickness in the middle than at the edges. It may be caused by a deflecting (bending) of the rolls or by worn rolls.
Crush Test	See Compression Test
Cu	Copper
Cut Off	This operation is used primarily to: <ul style="list-style-type: none"> A. Cut the tubing to the length required by the customer B. Obtain metallurgical samples to provide material for testing required by the customer's specifications.
Cut Length	Refers to tubing ordered to a specified length and permitting a tolerance of a standardized fraction of an inch over but nothing under the specified length.

C.W. Continuous weld
C.W.T. Per hundred weight

D

Dead Soft See Heat Treatment

Deburring is a process used when the customer does not wish any deformation or burrs on the ends of the tubing.

Decarburization The loss of carbon from the surface of a ferrous alloy.

De-dimpling Removal of dimple by pulling the tube back to round.

Deep Drawing forming shaped articles or shells by forcing metal into a die.

Density The mass per unit volume of a substance, usually expressed in the tubing industry in pounds per cubic inch.

Descaling As related to tubing, the process of cleaning the steel surface after oxidation. Generally pickling or shot or sand blasting is used.

Dia. Diameter

Die Cut is an applicable to lengths shorter than eight feet, and there is minimal deformation. The die cut ends do have a slight burr.

Dimension of Tubing

1. A round tube section has three dimensions, any two of which may be varied. The three dimensions are outside diameter (O.D.), inside diameter (I.D.) and wall thickness or gauge.
 - a. O.D. – OUTSIDE DIAMETER – specified in inches and fractions of an inch, or in inches and decimals of an inch.
 - b. I.D. – INSIDE DIAMETER – specified in same terms as the O.D.
 - c. WALL THICKNESS OR GAUGE – specified in either fractions of an inch, decimals of an inch or by a “Wire Gauge” number. In the United States, the “Birmingham Iron Wire Gauge”, designated “Bwg” or B.W.G”.
2. Nominal as applied to any of these dimensions refers to the theoretical or stated single value of that dimension. The dimensions ordinarily specified by the customer are termed nominal.
3. Average dimensions are those secured by averaging a series of micrometer readings of sufficient number to assure that all parts of the tube are within the maximum and minimum dimensions specified.
4. Maximum and minimum referring to the greatest and least values of any dimensions as agreed upon, constitute the limits within which all such dimensions must fall.

<i>Dimpling</i>	Occurs when tubing is punch cut. A depression is formed by the cutting operation.
<i>'DIN'</i>	indicates a foreign specification, usually in metrics
<i>DOM</i>	Drawn over mandrel. (A cold working process) See Mandrel drawn for explanation (Note that DOM refers to an ERW product)
<i>Drawing</i>	<ol style="list-style-type: none"> 1. forming parts by causing plastic, flow of metal in dies 2. reducing cross section of tubing by pulling it through a die 3. another term for tempering
<i>Ductility</i>	The ability of a material to deform plastically without fracturing. Measured by elongation in a tensile test

E

<i>Eccentricity</i>	The displacement of the I.D. of the tube with respect to its O.D. Eccentricity results in the variation of wall thickness generally found in seamless tubing. The distance between the centers of the circles prescribed by the outside diameters. (Only wall thickness is affected by tube eccentricity)
<i>Eddy Current</i>	Non-destructive testing method using eddy current flow for the purpose of recognizing a discontinuity in the piece being tested.
<i>Elastic Deformation</i>	Temporary changes caused in dimensions by stress. The material returns to the original dimensions after removal of the stress.
<i>Elastic Limit</i>	A measure of the maximum stress that may be applied to a tube without leaving a permanent deformation or strain after the stress is released.
<i>Electric Furnace (EF)</i>	A method to produce steel, basically from scrap metal.
<i>Electric Resistance Weld (ERW)</i>	Probably the most common method of producing tubing. Basically hot rolled sheet or strip is put through a gradual forming operation until the edges are joined together by the introduction of an electric charge, which fuses – or welds – the edges together. ERW is a cold forming operation since the steel is formed without heating the sheet or strip.
<i>Elongation</i>	The amount of permanent extension in the vicinity of the fracture in the tension test; usually expressed as a percentage of the original gauge length, as 25% in 2 inches. Elongation may also refer to the amount of extension at any stage in any process that elongates a body continuously, as in rolling.
<i>Erosion</i>	The abrasion of metal or other material by liquid or gas and sometimes by corrosion.

Extrusion Production process in which steel is forced by compression through a die into solids (rounds or special shape) or through a die and over a mandrel to form a tubular shape.

F

Fatigue The tendency for a metal to break under conditions of repeated cyclic stressing considerably below the ultimate tensile strength.

Fatigue Limit Finish The maximum stress that a metal will withstand without failure. In the tubing industry, refers to the type of surface and end condition desired or existing in the finished product.

Flame Cutting Severing a piece of steel by burning a portion out by means of an oxyacetylene torch.

Flame Hardening A process of hardening a ferrous alloy by heating it above the transformation range by means of a high temperature flame and then cooling as required.

Flange The annular projection formed at right angles to the tube. As a test, used to evaluate tube weld quality and overall soundness.

Flare Test The tapered expansion of a welded tube over a cone having various degrees and of various lengths.

Flash A thin fin of metal formed at the sides of a forging or weld when a small portion of metal is forced out between the edges of the forging or welding process.

Flash Condition When the edges of the tubing are brought to fusion temperature, side roll exerts sufficient pressure to press the heated edges together, forming a welded joint. A small amount of metal is extruded on the O.D. and the I.D. of the tube. No foreign or additional metal is added in the operation. The extruded metal on the outside is always removed to form a smooth outside surface.

Flash Controlled .005"-.010" means that the inside flash is controlled to the maximum limits shown. This is usually required where the customer telescopes one size into another, uses a mandrel in fabrication, or is inserting something inside the tube.

Flash-In Tubing with the weld flash left on the inside of the tube.

Flash-Removed From either the O.D. or the I.D.

Flat Rolled Product(s) Basically a mill terminology for; hot rolled bands and sheets...cold rolled sheets...hot rolled plates either in coil form or flat...cut-to-length.

Flattening Test	A test for either or both the tube base metal and weld line where a ring from the tube or end is flattened. The weld line is positioned 0° or 90° to the applied force and the ring flattened to a specific height. Examination is made during the test for signs of cracking.
F.O.B.	Free On Board
Forging	Used as a general term to describe the rolling, pressing or hammering of steel, which displaces the metal under compression by a locally applied force, usually at, hot working temperatures.
Forming	To shape or fashion with the hand or tools or by a shape or mold.
Forming Properties	Those physical and mechanical properties that allow a steel to be formed without injury to the steel in the finished product.
Fracture Stress	The maximum principal true stress (fracture load divided by fracture area)
Fracture Test	Breaking a piece of metal for the purpose of examining the fractured surface to determine the structure or carbon content of the metal or to detect the presence of internal defects.
FRT	Freight
Full Anneal	A softening process, in which, a ferrous alloy is heated to a temperature above the transformation range and, after being held for a sufficient time at this temperature, is cooled slowly to a temperature below the transformation range. The alloy is ordinarily allowed to cool slowly in the furnace, although it may be removed and cooled in some medium that insures a slow rate of cooling.

G

Galvanizing	The process of applying coating of zinc to steel. This zinc is applied by either the hot dip or electrolytic deposition.
Galvannealed	Is a galvanized sheet steel, which is altered by heat treatments or other processes immediately after coating, before zinc solidifies. The coating produced consists of an iron-zinc alloy and has a rougher appearance than the surface of regular coating. Sheets produced in this manner are dull gray in color, have no spangle and after proper preparation, is well suited for painting.
Gauge (Gage is also correct)	A measurement of thickness. There are various standard gauges such as United States Standard Gauge (USS), Galvanized Sheet Gauge (GSG), Birmingham Wire Gauge (BWG or B.W.G.) Birmingham Wire Gauge is commonly used by the welded tube industry.

Grain Size	The average size of the individual crystals in metals expressed as: <ol style="list-style-type: none"> 1. The ASTM grain size 2. The austenitics grain size 3. The number of grains per unit area as viewed mettallorgraphically or 4. Some average value of the grains
Grains	Individual crystals in metals
Gross Ton (G.T.)	2,240 pounds
Gun Metal Finish	Welded tubing normalized, annealed, or stress relieved in a controlled atmosphere furnace which exhibits a gun metal finish.

H

HR P&O	Hot Rolled pickled & oiled
Hardenability	The property in steel that determines the depth and distribution of hardness induced by cooling from a suitable elevated temperature. The depth of hardness can vary with the cooling rate.
Hardness	A mechanical property of metals related to the tensile strength, and thereby roughly to ductility or formability. Hardness is usually expressed in terms of the method of measurement, such as, <ol style="list-style-type: none"> 1. The resistance to penetration or indentation as in the Rockwell, Brinnel, Vickers and Knoop tests. 2. Stiffness of temperature of wrought products 3. Machinability characteristics
Heat Analysis	The term applied to the chemical analysis representative of a heat or blow of steel and is the analysis reported to the purchaser. It is determined by analyzing (for such elements as have been specified) a test ingot sample obtained from part of the heat or blow during the pouring of the steel from a ladle.
Heat Treatment	A combination of heating and cooling operation applied to a metal or alloy in the solid state to obtain desired conditions or properties. Heating for the sole purpose of hot working is excluded from the meaning of this definition. See various types below: <p>Age Hardening: Hardening by aging, usually after rapid cooling or cold working. Hardening is a result of a precipitation process, often submicroscopic, which occurs when a super-saturated solid solution is naturally aged at atmospheric temperature or artificially aged in some specific range of elevated temperature. Aging occurs more rapidly at higher temperatures.</p>

Air Hardening: Heating a suitable grade of steel with high hardenability above the critical temperature range and then cooling in air for the purpose of hardening.

Annealing: Annealing is a heat treatment process, which usually involves a relatively slow cooling after holding the material at some time at the annealing temperature. The purpose of the annealing treatment may include the following” (a) to induce softness, (b) to remove internal stresses, (c) to refine the grain size, (d) to modify physical and/or mechanical properties, (e) to produce a definite microstructure, (f) to improve machinability. It is generally desirable to use more specific terms in describing the heat treatment to be used, e.g., finish anneal, full anneal or medium anneal, as applicable.

Bright Anneal: Carried out in a controlled furnace atmosphere, so that surface oxidation is reduced to a minimum and the tube surface remains relatively bright.

Dead Soft: A heat treatment applied to achieve maximum softness and ductility.

Finish Anneal: Heating of cold-worked tubing to a temperature above the upper critical and slow cooling below the lower critical.

Medium Anneal: Subjecting tubing to a sub critical temperature to obtain specific mechanical properties.

Normalize: Normalizing is a process which consists of heating to a temperature approximately 100°F above the upper critical temperature and cooling in still air.

Quenching: A process of rapid cooling from an elevated temperature, by contact with liquid or gasses.

Soft Anneal: A high temperature stress relieving anneal usually performed in the temperature range of 1250° to 1350°F. This anneal reduces hardness and strength of a cold worked steel to achieve near maximum softness.

Spheroidizing Anneal: A general term, which refers to heat treatments that promote spheroidal or globular forms of carbide in carbon or alloy steels.

Stress Relieving: A heat treatment which reduces internal residual stresses that have been induced in metals by casting, quenching, welding, cold working, etc. The metal is soaked at a suitable temperature for a sufficient time to allow re-adjustment of stresses. The temperature of stress relieving is always below transformation range. Finish anneal, medium anneal and soft anneal (sub-critical) describe specific types of stress relief anneals.

- Tempering:** Reheating quenched or normalized steel to a temperature below the transformation range (lower critical) followed by any desired rate of cooling.
- High Strength Steel** Commonly known as High Strength Low Alloy (HSLA) – A specific class of low alloy steels in which increased mechanical properties and, usually, good resistance to atmospheric corrosion are obtained with moderate amounts of one or more alloying elements other than carbon. You can also achieve high strength through physical not chemical properties.
- Honing** Honing is used to modify the inside surface of tubing used for hydraulic cylinders to meet the cylinder manufacturers’ requirements for surface finish (micro-inch) and ovality. The process uses honing stones, held on a rotating shaft. The honing head is passed through the I.D. in a helical pattern. The honing pressure, stone grit and number of passes control the final I.D. dimensions of the tube.
- Hot Finished Seamless** Tubing produced by rotary piercing, extrusion and other hot working processes without subsequent cold finishing operations.
- Hot Forming** Working operations, such as bending and drawing sheet and plate, forging, pressing and heading performed on metal heated to temperatures above room temperature.
- Hot Quenching** A process of quenching in a medium at a temperature substantially higher than atmospheric temperatures.
- Hot Rolled** Coiled – Bands and Sheet – The majority of continuous welded tubing is produced from coiled (HR) bands and sheets. Understand that HR sheets and HR bands are basically the same product, same chemistry, quality, etc. The difference is that bands are shipped “black”, not pickled and have a surface that is suitable for certain products. Thus the type of tube specification, method of manufacture, etc. dictates to the supplier whether HR bands or HR sheets are used.
- Hot Rolled ERW Tubing** As welded electric resistance welded tubing made from hot rolled strip or sheet.
- Hot Stretched Reduced** A process that is utilized to obtain tubing in smaller diameter sections. (Material is heated and while hot is stretched and reduced in diameter to achieve desired wall).
- Hydraulic Fluid Line Tubing** Probably the highest quality carbon or alloy tubing made. The tubing has special conditions; surface finish, flarability, certain Rockwell hardness, restrictive elongation and in many cases, special pressure testing procedures.

Hydrostatic Testing A test in which a liquid, usually water, under pressure, is used internally to detect and locate leaks in a tube of a fabricated structure. High-pressure water test to pre-determine pressures as required by specifications.

I

I.D. Inside Diameter

Ingot Usually first solid form of steel. Suitable for re-working or re-melting.

Impact Testing A test to determine the energy absorbed in fracturing a test bar at high velocity. The test may be in tension or in bending, or it may properly be a notch test is present, creating multi-axial stresses.

Inclusion Particles of non-metallic impurities, usually oxides, sulfides, silicates and such, which are mechanically held in steel during and after solidification.

Induction Hardening A process of hardening a ferrous alloy by heating it above the transformation range by means of electrical induction and then cooling as required.

Induction Heating A process of heating by electrical induction.

Iron A metallic element. In the steel industry, iron represents the product of a blast furnace containing 92% to 94% iron. Blast furnace iron is also called pig iron or hot metal.

Iron Pipe Size (I.P.S.) Same as nominal size from 1/8" to 12"

J

Jominy Test Hardenability test performed usually on alloy steels to determined depth and degree of hardness resulting from a standard end quenching method with cold water.

K

Killed Steel Steel deoxidized with a strong deoxidizing agent such as silicon or aluminum in order to reduce the oxygen content to a minimum so that no reaction occurs between carbon and oxygen during solidification.

Kip A term indicating 100 pounds

KSI K equals 1000, thus the term is actually K(1000)PSI. The P has been dropped and KSI is the new term. (i.e. 50 KSI = 50,000PSI)

L

Ladle A large vessel into which molten steel or molten slag is received and handled.

Ladle Analysis Chemical analysis obtained from a sample taken during the pouring of the steel.

Laminations Defects resulting from the presence of blisters, seams or non-metallic inclusions aligned parallel to the worked surface of a metal.

Lap A surface defect appearing as a seam caused from folding over, during the hot rolling, fins or sharp corners and then rolling or forging, but not welding, them into the surface.

LGTH Length

M

Machinability A measure of the relative ease with which steel may be machined.
Machining In general, the cutting away of the surface of a metal by means of power driven machinery. Specifically, a method of conditioning steel by machining away the surface.

Magnaflux An inspection given to highly stresses parts of steel by suitably magnetizing the material and applying a prepared magnetic powder which adheres to it along lines of flux leakage...the existence of surface and subsurface discontinuities can be shown.

Mandrel
1. A rod used to retain the cavity in hollow metal products during working
2. A metal bar around which other metal may be cast, bent, formed or shaped.

Mandrel Drawn Used to obtain closer O.D. and I.D. tolerances, or O.D. and wall thickness tolerances. Available with improved mechanical properties (If ERW product is mandrel drawn it is designated as D.O.M.)

Mechanical or Destructive Test **Tension Test** – This test is used to determine the strength and ductility of tubular products. It is approved ASTM practice to make tension tests on a full section of the tube or pipe when within the capacity of the testing machine. When it is impractical or impossible to test in full section, the test is made on a strip machined from the tube or pipe. In the case of a tube or

pipe having a wall thickness of $\frac{3}{4}$ inch or heavier, it is approved ASTM practice to use standard ASTM round two-inch gauge length specimen.

Flattening Test- This test is used to determine ductility, and is conducted by subjecting rings cut from the tube or pipe to a prescribed degree of flattening between parallel plates. The severity of the flattening tests is measured by the distance between the parallel plates and is varied according to the dimensions, composition and condition of the tube or pipe. The flattening test specimen should not be less than 2- $\frac{1}{2}$ inches in length and should be flattened cold to the extent required by the applicable specification.

Reverse Flattening Test – This test is designed primarily for application to electric welded tubing for the detection of flash overlaps and lack of weld penetration. The specimen consists of a length of tubing approximately 4 inches long, which is split longitudinally 90° on each side of the weld. The sample is then opened and flattened with the weld at the point of the maximum bend.

Crush Test – This test, sometimes referred to as an upsetting test, is usually made on boiler and other pressure tubes for evaluating ductility. The specimen is a ring cut from a tube, usually about 2- $\frac{1}{2}$ inches long; for tubing $\frac{3}{4}$ O.D. and smaller, the specimen length is usually about 2- $\frac{1}{2}$ times the O.D. It is placed on end and crushed endwise by hammering or pressing to the distance prescribed in the application specification.

Flange Test – This test is made to determine the ductility of pressure tubes and their ability to withstand the operation of beading into a tube sheet. The test is made on a ring cut from a tube, usually not less than 4 inches long and consists of having a flange turned over at right angles to the body of the tube to the width required by the applicable specification.

Bend Test – The bend test is bent at room temperature to an inside diameter, as designated by the applicable product specification, to the extent specified without major cracking on the outside of the bent portion. The speed of bending is ordinarily not an important factor.

Impact Test – This is a test in which a selected specimen, machined or surface ground and notched, is struck and broken by a single blow in a specially designed testing machine, and the energy absorbed in breaking the specimen is measured.

Hardness Test – The hardness test is a measure of resistance to penetration. In the case of steel the hardness test is a quick approximation of tensile strength. The most commonly used methods to check hardness are the Rockwell and Brinell Tests.

Hydrostatic Test – The hydrostatic test consists of filling the tube with test fluid and applying hydrostatic pressure. This tests is not intended to bear a direct relationship to bursting pressures, working pressures or design data.

Mechanical Properties Those properties of a material that reveal the elastic and inelastic reaction when force is applied, or that involve the relationship between stress and strain; for example, the modulus of elasticity, tensile strength and fatigue limit. These properties have often been designated as “physical properties”; but the term “mechanical properties” is much preferred.

Mechanical Tubing Used for a variety of mechanical and structural purposes as opposed to pressure tubing, which is used for the conduction of fluids under pressure. It is commonly manufactured to consumer specifications covering chemical analysis, mechanical properties and often to special dimensional tolerances. It is used for such a variety of purposes that it is impractical to subdivide it into classifications such as are used for other classes of tubing.

Metallurgy The science which deals with the extraction of metals from their ores and the adaptation of these metals to the uses for which they are intended.

Minimum Wall Any wall having tolerances specified all on the plus side. Minimum thickness permissible calculated by subtracting minus tolerance from nominal wall.

Mn Manganese

Modulus of Elasticity The slope of the elastic portion of the stress-strain curves in mechanical testing. The unit elongation divides the stress. The tensile or compressive elastic modulus is called “Young’s modulus”; the torsional elastic modulus is known as the “shear modulus”, or “modulus of rigidity”.

Modulus of Rigidity In torsion testing, the ratio of the unit shear to the displacement caused by it’s per unit length in the elastic range. This modulus corresponds to the modulus of elasticity in the tension test.

Molybdenum An alloying element commonly used in low alloy and other steels to increase hardenability; commonly called moly.

N

N.B.S.	National Bureau of Standards
N.F.P.A.	National Fluid Power Association
Net Ton	2,000 pounds
Nitriding	A process of case hardening in which a ferrous alloy, usually of special composition, is heated in an atmosphere of ammonia or in contact with nitrogenous material to produce surface hardening by the absorption of nitrogen, without quenching.
Non-Destructive Testing	Methods of detecting defects without destroying or permanently changing the material being tested. Test methods include ultrasonic, eddy current, magnetic particle, liquid, penetrant and X-Ray.
Normalize	The normalizing process which is commonly applied to steel articles of heavy section consists of heating to a temperature about 100° F above the critical range and cooling in still air.
<h2>O</h2>	
O.D.	Outside Diameter
Oiling	Application of a suitable oil to final product to retard rusting. Where surface is a consideration, it is also desirable in reducing friction scratches that may develop in transit. The oil coating is not intended to serve as a lubricant for subsequent fabrication.
Open Hearth Furnace	Now obsolete method of turning iron into steel. There may be only a few open-hearth furnaces left, as they have become obsolete due to the introduction of the Basic Oxygen Furnace, which is faster and thus less costly.
Ovality	The difference between the maximum and minimum diameters of any one section of round tube, by actual measurement.
Oxidation	In its simplest terms, oxidation means the combination of any substance with oxygen. Scale developed during heat treatment is a form of oxidation.
Oxide	A compound consisting of oxygen and one or more metallic elements.
Oxygen Steel	Steel made with the use of oxygen blast as an alternative or adjunct with air to oxide impurities in the melting process. Increases rapidly of the process.

P

Pass	<ol style="list-style-type: none">1. Movement of a piece of steel through a stand of rolls.2. The open space between two groove rolls through which is rolled the steel, which is being processed.
Passivating	Immersion of steel in an acid bath to remove surface impurities and to render the surface passive.
PCS	Pieces
Physical Properties	Those properties familiarly discussed in physics, exclusive of those described under mechanical properties; for example, density, electrical conductivity, coefficient of thermal expansion. This term has often been used to describe mechanical properties, but this usage is not recommended.
Pickle	Chemical or electrochemical removal of surface oxides.
Pickled Tubing	Tubing has had the scale from hot fabrication or heat treatment removed by one of several types of acid solutions.
Pickling	An operation by which the scale formed on the surface of the tube during piercing or heat treatment is removed by the chemical action in sulfuric acid. After the acid bath, the tubing is rinsed in water.
Piercing	A seamless tube making method in which a hot billet is gripped and rotated by rolls or cones and directed over a piercing point which is held on the end of a mandrel bar.
Pig Iron	Blast furnace iron
Pipe	A cavity formed by contraction in metal (especially ingots) during solidification of the last portion of liquid metal. A tubular form of steel, generally of heavier wall thickness than tubing and made to a "nominal" outside diameter, e.g. 2" pipe is 2-3/8" outside.
Pipe Size Tubing	Can be competitive product vs. pipe...in price and physical properties. Not pressure tested...but can be used in a variety of non-code...non-specification applications.
Pit	A sharp depression in the surface of metal.
P.I.W.	Pounds per inch of width
Plug	A rod or mandrel that fills a tube as it is drawn through a die.
Profilometer	An instrument used for measuring surface finish. The vertical movements of a stylus as it traverses the surface are amplified electromagnetically and recorded (or indicated) as the surface roughness.
PSI	Pounds per Square Inch

Q

Quality	Refers to the suitability of the steel to meet specified requirements for which is intended.
Quench	Quenching is a treatment consisting of heating uniformly to a temperature above the critical range and cooling rapidly in a liquid medium.
Quench Hardening	A process of hardening a ferrous alloy suitable composition by heating within or above the transformation range and cooling at a rate sufficient to increase the hardness substantially. The process usually involves the formation of martensite.
Quenching	A process of rapid cooling from an elevated temperature by contact with liquids, gasses or solids.
Quenching and Tempering	Consists in heating the steel to the proper temperature, holding at that temperature for a suitable time to effect the desired change in structure and quenching in a composition and cross section. After quenching, the steel is re-heated to a predetermined temperature below the critical range and then cooled under suitable conditions.

R

RMS	Root Mean Square
Random Length	Tubing produced to a permissible variation in length.
Range	The term range in connection with chemical or physical properties, lengths, tolerances, etc is the numerical difference between the maximum and minimum of the given limits. Thus, carbon 0.15 to 0.25 percent is considered to be a ten-point range.
Recessed	Counter-bored for a short distance when applied to couplings.
Reduction Area	In a tensile test, the difference between the original cross-sectional area and that of the smallest area at the point of rupture; usually stated as a percentage of the original area; also called "conjunction of area".
Rephosphorized Steels	The series 1200 open-hearth steels are both rephosphorized and resulphurized. The phosphorus, by increasing the strength and hardness of the steel, promotes chip breaking in cutting operations. The amount of phosphorus is limited, however, because the excessive hardness produced by large quantities would actually be deleterious to machining characteristics.

Resilience	The tendency of a material to return to its original shape after the removal of a stress that has produced elastic strain.
Resistance Welding	A type of welding process in which the work pieces are heated by the passage of an electric current through the contact. Such processes include spot welding, seam or in-line welding and percussion welding.
Resulphurized Steels	The sulphur, which is added for the purpose of increasing machinability, combines with the manganese in steel and precipitates as manganese sulfide inclusions. Depending on their size and orientation, the inclusions favor machinability by causing the formation of a broken chip instead of a stringy one and by providing a built in lubricant. The chip that forms breaks more readily and is particularly helpful in milling, tapping, slotting and reaming, since the chip is forced to move within a confined area in each of these operations.
Random Length (R/L)	Varying lengths of tubing
Rockwell Hardness	See Hardness
Roll Forming	(As applied to tube manufacturing) A process of forming flat-rolled material into cylinders (tubes).
Roller Straightening	A process involving a series of staggered rolls, between which rod, tubing and shapes are passed for the purpose of straightening. The process consists of a series of bending operations.

S

STINA	Steel Tube Institute of North America
Scale	An oxide of iron, which forms on the surface of hot rolled steel.
Scale Free	The absence of loose scale on a hot finished surface, typically achieved through pickling or blasting.
Scarfiging	Cutting surface areas of metal objects, ordinarily by using a gas torch. The operation permits surface defects to be cut from ingots billets or the edges of plate that are to be beveled for butt-welding.
Seam	On the surface of metal, a crack that has been closed but not welded; usually produced by some defect either in casting or in working, such as blowholes that have become oxidized or folds and laps that have been formed during working. Seam also refers to lap joints, as in seam welding.
Seamless (SMLS)	Tubing or pipe without a seam or weld.
Semi-Killed Steel	Are characterized by variable degrees of uniformity in composition, which are intermediate between those of killed and rimmed steel. They are deoxidized less than killed steels. Most

carbon plates are made from semi-killed steels except where higher quality is specified or required.

Sheet	A rolled steel product rectangular in cross section and form of thickness 0.006 through 0.229 inch with sheared, slit or sawed edges.
Shell	In tubing terminology, generally indicates a “hollow”.
Sink Drawing	Sink drawn tubing is produced by drawing the weld through a die with only the O.D. being controlled. This operation is performed when closer tolerances or a better surface might be required on the O.D. only and for enhanced mechanical properties. Sink drawn tubing can be produced from either hot rolled or cold rolled steel and I.D. flash can be any of the conditions described above.
Sizing Methods	HF – Hot Finished, CW – Cold Worked, RT – Rough Turned, G – Ground
Skelp	A heavy gauge hot rolled strip product basically used in the production of continuous Buttweld pipe. Is sometimes used on the production of heavy wall tubing.
Skiving	A process by which material is removed from the I.D. with a head containing several cutting tools.
Slab	A semi-finished steel block having an oblong cross-section in which width is at least twice thickness. It differs from a bloom, which has a square or nearly square cross-section.
Slitting	The longitudinal splitting of the overall width of a flat product through rotary knives mounted on a rotating arbor to reduce the original width or to cut two or more separate strips.
Soft Anneal	See Heat Treatment
Special Smooth (SSID)	A cold drawn tube in which special attention is paid to the internal I.D. surface. Depth of pits and scores in I.D. are guaranteed to be below published maximum depths. Micro-inch finish is guaranteed in ERW tubes.
Specification	A document defining the measurements, tests and other requirements to which a product must conform – typically covering chemistry, Mechanical properties, tolerances, finish, reports, marking and packaging.
Spheroidize Anneal	See Heat Treatment
Spiral Eccentricity	To some degree, spiraling eccentricity occurs in all seamless steel tubing as a natural consequence of the rotary piercing process. The effect may be compared to gun barrel rifling. The eccentric spiral makes a complete revolution in approximately every 30” of tube.

Stainless (Steel)

A trade name given to alloy steels that is corrosion and heat resistant. The chief alloying elements are chromium, nickel, molybdenum and silicon in various combinations with a possible small percentage of titanium, vanadium, etc. By definition, a steel is called "Stainless" when it contains 10.5% or more chromium.

Steel

An iron-based alloy, malleable in some temperature range as initially cast, containing manganese, usually carbon, and often other alloying elements. In carbon steel and low-alloy steel, the maximum carbon content is about 2.0%; in high alloy steel, about 2.5%. The dividing line between low-alloy and high-alloy steels is generally regarded as being at about 5% metallic alloying elements. Steel is to be differentiated from two general classes of "irons"; the cast irons, on the high carbon side, and the relatively pure irons such as ingot iron, carbonyl iron, electrolytic iron, on the low side. In some steel containing extremely low carbon, the manganese content at least 0.25% ingot iron contains considerably less.

Stencil

Method of painting identification... specification, size, wall, grade, test pressure, method of manufacturer and mill identification are usually indicated.

Strand(s)

Product of continuous cast process.

Strand Casting

Strand casting is the direct casting of steel from the ladle into slabs. When two or more heats are cast without interruption, the process is called continuous strand casting. In strand casting, a heat of steel is tapped into a ladle in the conventional manner. The liquid steel is then teemed into a tundish, which acts as a reservoir to provide for a constant casting rate. The steel flows from the tundish into the casting machine and rapid solidification begins in the open-ended molds. The partially solidified slab is continuously extracted from the mold. Cooling the moving steel surface completes solidification. More than one strand may be cast simultaneously, depending upon the heat and the slab size. A reduction in size may be carried out by hot working the product as it exits from the strand prior to cutting the cast section to length. Chemical segregation is minimized due to the rapid solidification rate of strand cast product.

Steel produced from a strand casting operation is always fully killed steel, thus generally considered to have excellent surface quality.

Stress

The load per area of unit. Ordinarily stress-strain curves do not show the true stress (load divided by area at that moment), but a fictitious value obtained by always using the original area.

<i>Stress Free</i>	The term used to designate tubing, which has been hot rotary straightened. Since no cold working stresses are developed in hot rotary straightening, the stress relief temper is not necessary. Cold rotary straightening and stress relieving can be substituted for hot rotary straightening.
<i>Stress Relief Anneal</i>	See Heat Treatment
<i>Stress Relieving</i>	A process of reducing residual stresses in a metal object by heating the object to a suitable temperature and holding for a sufficient time. This treatment may be applied to relieve stresses induced by casting, quenching, normalizing, machining, cold working or welding.
<i>Stretch Reduce</i>	A technique employed in the manufacture of CW pipe in which one or several master sizes of pipe are produced and then stretched reduced through a number of rolls to achieve a variety of pipe diameters. Also used in certain instances in seamless and ERW manufacturing.
<i>Stretcher Leveling</i>	Leveling where a piece of metal is gripped at each end and subjected to a stress higher than its yield strength to remove warp and distortion. Sometimes called patent leveling.
<i>Strip</i>	A narrow (usually up to 12" wide) flat rolled sheet product, which serve as the raw material for welded tube.
<i>Structural Tubing</i>	Tubing used primarily for structural applications and produced in squares, rectangles, rounds and shapes.
<i>Submerged Arc Welded (SAW)</i>	A method of producing very large O.D. tubular products.
<i>Sunk Drawn</i>	Tubing drawn through a die with no inside mandrel to control I.D. or wall thickness.
<i>Surface Inspection</i>	The inspection of the surface of products for defects such as ingot cracks, scabs, seams, burned steel, laps, twist, guide marks, etc.
<i>Swaged</i>	A mechanical reduction of the cross sectional area of a metal performed hot or cold by forging, pressing or hammering.
<i>Swaging</i>	Is a method of cold working tubing in which the reduction is accomplished by hammering tubing to the desired dimension. The hammer blows are delivered rapidly against the outside surface of the tube. An inside mandrel may or may not be used.

T

<i>Tapping</i>	The act of pouring molten metal from a furnace into a ladle.
<i>Teeming</i>	The act of pouring molten metal from a ladle into an ingot mold.
<i>Temper</i>	A condition produced in a metal or alloy by mechanical or thermal treatment and having characteristic structure and mechanical properties. A given alloy may be in the fully softened or annealed

temper, or it may be cold worked to the hard temper, or further into spring temper. Intermediate tempers produced by cold-working (rolling or drawing) are called “quarter-hard”, “half-hard” and “three quarters hard” and are determined by the amount of cold reduction and the resulting tensile properties. In addition to the annealed temper conditions produced by thermal treatment are the solution heat-treated temper and the heat-treated and artificially aged temper. Other tempers involve a combination of mechanical and thermal treatments and include that temper produced by cold working after heat treating, and that produced by artificial aging of alloys that are pre-cast, as-extruded, as-forged and heat treated, and cold-worked.

A term closely associated with flat rolled sheet products...particularly cold rolled strip and sheet. It is generally measured by Rockwell hardness...and is often the key to successful fabrication and proper end uses application.

A customer may specify any of a various hardness levels or tensile properties. A tube producer needs to know the required temper. It is suggested that desired physical properties be discovered/specified...in order that the proper heat treatment to be applied.

Tempering

A process of re-heating quench-hardened or normalized steel to a temperature below the transformation range, and then cooling at a rate desired.

Tensile Strength

The value obtained by dividing the maximum load observed during tensile straining until breakage occurs by the specimen cross-sectional area before straining. Also called “Ultimate Strength”.

Tensile Test

The three results usually reported are:

- A. *Yield Point* – The stress at which there is a marked increase in deformation without a proportional increase in load.
- B. *Tensile Strength* – The maximum load observed during the test before breakage occurs.
- C. *Elongation* – The amount that a specified gauge length containing the fracture has stretched during the test, expressed as a percentage.

Thermal Treatment

Any treatment listed under annealing or heat-treating.

Tolerance(s)

Permissible variation(s) or deviation from a dimension.

Torsion

Strain in a material by a twisting action. Correspondingly, the stress within the material resisting the twist.

Toughness

A measure of ability to absorb energy and deform plastically before fracturing.

<i>Tube Hollow</i>	As a generic term for any ERW...SMLS...or CDBW tube ready for further processing...such as cold drawing.
<i>Tube Round</i>	A term used to describe a seamless product ready to be shipped. Also sometimes used instead of Tube Hollow.
<i>Tubing</i>	A non-standard hollow shaped product with a relatively uniform wall thickness, generally round, square or rectangular, and manufactured to specified requirements for dimensions, chemical analysis, mechanical properties and other characteristics (such as surface) required for applications in aircraft, sanitary, mechanical, pressure, ornamental or structural uses. It is generally specified to two dimensions, i.e., O.D. (Outside Diameter) and wall, I.D. (Inside Diameter) and wall, or O.D. and I.D. It is not primarily designed for use with standard threaded pipe couplings or for applications where standard or heavy wall pipe is normally used.
<i>Turkshead</i>	Consists of a frame, mounted on a draw bench, containing four rolls with their axis at right angles and so positioned as to provide an opening corresponding to the section to be formed. Round tubes are pulled through the rolls without internal mandrel support. The outside corners of sections processed by these means do not have consistent radii. Also used in the manufacture of structural tubing.
<i>Turning</i>	A method for removing the surface from a work piece by bringing the cutting edge of a tool against it while the piece or tool is rotated.

U

<i>Ultimate Strength</i>	The greatest load per square inch of original cross-sectional area carried during a tension test to failure. The term “ultimate strength” is preferred to “tensile strength”.
<i>Ultrasonic Testing</i>	The method of detecting defects in tubes or welds by passing high frequency sound waves into a material then monitoring and evaluating the reflected signals.
<i>Unified Numbering System (UNS)</i>	Was conceived and initiated by the SAE (Society of Automotive Engineers). It is used to supplement already existing designation systems (i.e. AISI, ASTM, AMS, etc) It is just an attempt to coordinate various systems into an overall system. The Unified Numbering System for metals and alloys (UNS) provides a means of correlating many nationally used metal and alloys numbering systems currently administered by societies, trade associations, and those individual users and producers

of metal and alloys. This system avoids the confusion caused by the use of more than one identification number for the same metal and alloy, and the opposite situation of having the same number assigned to two or more different metals or alloys. A UNS designation is not, in itself, a specification, since it establishes no requirements for form, condition, property, or quality. It is unified identifier of a metal or alloy for which controlling limits have been established in specifications published elsewhere. The UNS establishes 18 series of designations for metals and alloys- 17 of which are currently active. Each UNS designation consists of a single letter prefix followed by five digits. For example, A for Aluminum, P for Precious Metals, S for Stainless Steels.

Prefixes used in UNS

Axxxxx	Aluminum and Aluminum Alloys
Cxxxxx	Copper and Copper Alloys
Exxxxx	Rare Earth and Similar Metals and Alloys
Fxxxxx	Cast Irons
Gxxxxx	AISI and SAE Carbon and Alloy Steels
Hxxxxx	AISI and SAE H-Steels
Jxxxxx	Cast Steels (except Tool Steels)
Kxxxxx	Miscellaneous Steels and Ferrous Alloys
Lxxxxx	Low Melting Metals and Alloys
Mxxxxx	Miscellaneous Non-ferrous Metals and Alloys
Nxxxxx	Nickel and Nickel Alloys
Pxxxxx	Precious Metals and Alloys
Rxxxxx	Reactive and Refractory Metals and Alloys
Sxxxxx	Heat and Corrosion Resistant Steels
Txxxxx	Tool Steels, Wrought and Cast
Wxxxxx	Welding Filler Metals
Zxxxxx	Zinc and Zinc Alloys

Upset

The product of any cold or hot forming of material in which the metal is thickened by being forced back into itself. It is usually done at a red heat by hammering or press forging. Upset tubes are those whose ends have their walls so thickened for a short distance, usually to such an extent that the treading leaves as great a thickness of metal below roots of threads as in the main body of tubes. Upset tubes are used often as stay tubes; they are sometimes called "stove tubes".

V

<i>Vacuum Treatment</i>	Processes designed to remove undesirable gases and/or to improve the internal micro-cleanliness of the product through use of a vacuum facility.
<i>Vacuum Melting</i>	Melting in a vacuum to prevent contamination from air, as well as to remove gases already dissolved in the metal; the solidification may also be carried out in a vacuum or at low pressure.
<i>Vickers Hardness Test</i>	See Hardness

W

<i>Weld Bead</i>	The built up portion of a weld, formed either from the filler metal or from the parent metal.
<i>Weld Pad</i>	A slight thickening of the wall in the weld area, which occurs during the continuous weld process.
<i>Welding</i>	A process to join two metals by the application of heat. Fusion welding, which includes gas, arc and thermal welding, requires that the parent metals be melted. This distinguishes fusion welding from brazing. In pressure or resistance welding, joining is accomplished by the use of heat and pressure without melting. The parts that are being welded are pressed together and heated simultaneously so that recrystallization occurs across the interface.
<i>Welding, Arc</i>	The method of uniting metals by use of an electric arc to raise the metal temperature to the fusion point.
<i>Welding, Electric Resistance</i>	The method of uniting metals by passage of an electric current through the metal, whereby the resistance of the metal results in a temperature increase at the abutting surfaces sufficient to effect union. Pressure is generally applied to insure intimate contact of the surfaces to be welded.
<i>Welding, Fusion</i>	Joining of two metals by heating the adjoining parts to the melting point. The molten puddle formed becomes the joint. Arc, gas and thermal welding are examples of fusion welding.
<i>Welding, Induction</i>	A form of electric resistance welding wherein the welding heat is generally within the metal by resistance to the flow of an electric current induced in the metal by means of a circumferential or tangent coil.

Welding, Inert Arc

Arc welding in an atmosphere of an inert gas, which serves to protect the molten puddle from contamination and oxidation by preventing air from coming in contact with the metal while it is at elevated temperatures.

Welding, Plasma Arc

The plasma arc process concentrates a jet stream of gas on a restricted weld area, providing more control and uniformity of the weld than was before possible. Used to produce welded stainless steel pipe and tubing in the heavier wall thicknesses.

Welding Stress

The stress resulting from localized heating and cooling of metal during welding.

Work Hardness

Hardness developed in metal as a result of cold working.

Wrought Iron

A commercial iron product, which contains little carbon and a considerable amount of, included slag that, due to subsequent working, gives fibrous structure to the iron.

Y**Yield Point**

In mild or medium carbon steel, the stress at which a marked increase in deformation occurs without increase in load. In other steels and in non-ferrous metals, this phenomenon is not observed. See Yield Strength.

Yield Strength

The stress at which a material exhibits a specified limiting deviation from proportionality of stress to strain. An offset on 0.2 percent is used for many metals such as steel, aluminum base, and magnesium base alloys, while a 0.5 percent total elongation under load is frequently used for copper alloys.

Z**Zinc Coating**

Is a type of galvanized coating, which protects the base metal against corrosive factors by sacrificing itself for the preservation of the metal. The selection of such a coating depends directly on painting appearance, durability, etc.