

Terminology

The following terms are generally used in processing of stainless steel.

A

Aging - Increasing the hardness, tensile and yield strengths of precipitation-hardening (maraging) stainless steels by heating at specified elevated temperatures that cause a constituent to precipitate from a super-saturated solid solution.

Annealing - The attaining of maximum softening of steel by heat treatment. Steel is heated, held at a suitable temperature and then cooled at a specified rate to produce reduced hardness or desired properties. Annealing is a general term specifying (a) for martensitic stainless steels, a maximum relief of those stresses caused by the decomposition of austenite to martensite on cooling which, in these steels, always occurs; (b) for chromium-nickel stainless steels, a maximum development of austenite and prevention of its subsequent decomposition; (c) for ferritic and austenitic stainless steels, the elimination of residual internal stress from cold working; and (d) for welded steels, the elimination of residual internal stress from welding. The latter two are designed to relieve stress, and are often called "stress relieving" treatments.

Austenite - A term designating a metallurgical phase of steels. In this phase, alloying elements and carbon are in solid solution. Austenite develops at specific elevated temperatures in martensitic stainless steels, is more or less permanent at all temperatures in austenitic stainless steels, and is virtually absent in ferritic stainless steels.

Austenitic Stainless Steel - A term used to identify the standard 200 and 300 series of chromium-nickel stainless steels on the basis of the metallurgical structure. Austenitic stainless steels are nonmagnetic in the annealed condition, becoming slightly to moderately magnetic when severely cold worked, depending upon their composition. These steels are not generally hardenable by heat treatment.

B

Billet - A semi-finished product, hot rolled from an ingot, generally square in cross section and from 1 1/2" to 6" in thickness. The name carries an arbitrary distinction from larger hot-rolled sizes that are commonly called blooms.

Bar - Any cold-finished round, square, octagon, hexagon or shape over 1/2" in diameter or size. Any cold-finished flat 3/8" and over in width and 1/8" and over in thickness. Also, any hot-rolled (not in coil form) or forged round, square, octagon, hexagon or shape 1/4" and over in diameter or size. Any hot-rolled flat 1/4" to 10" inclusive in width and 1/8" and over in thickness.

Bend Test - A test for determining relative soundness, toughness and ductility of a metal to be formed. The specimen is usually bent over a specified diameter through a specified angle for a specified number of cycles.

Bloom - A semi-finished product, hot rolled from an ingot, generally rectangular, and arbitrarily distinguished from the slab and billet as having a cross section greater than 36 square inches. The operational stage of the bloom is therefore between the ingot and the billet or slab.

Bright Annealing - A method of annealing in which the atmosphere of the furnace is specially selected and controlled to prevent discoloration of the steel by oxidation.

Brinell Hardness - A measurement of hardness by the Brinell hardness machine based upon the area of the impression made in the specimen by a 10 mm diameter ball pressed into the metal surface for at least 10 seconds under a load of 3000 kg.

Buffing - A polishing operation that utilizes a buffing compound on a prepared rotating buffing wheel that contacts the work.

C

Camber of Sheet - Curvature in the plane of sheet or strip.

Centerless Grinding - Grinding the surface of a bar that is supported by rollers rather than on centers.

Cold Working - Plastic deformation of a metal below its recrystallization temperature.

Consumable Electrode Vacuum Arc Remelting (VACCE) - Remelting a stainless steel ingot in a vacuum by a process in which the ingot is a consumable electrode. This process not only removes gases from the steel, but also minimizes impurities and segregation.

Corrosion - The attack upon metals by chemical agents, converting them to non-metallic products.

D

Decarburizing - Removal of carbon from solid steel by a reaction between the carbon in the surface area of the metal and some chemically active agent in the environment (such as oxygen).

Degassing - Removal of dissolved gases in liquid steel by subjecting the steel to a vacuum.

Degreasing - Removal of grease by immersion in detergent or suitable organic solvent such as trichlorethylene.

Descaling - Those processes concerned generally with removal of the oxide scale developing during hot operations such as rolling and heat treating.

Drawing - As applied to bar and wire, the term denotes a process by which material is pulled through a die for the purpose of changing the section and/or mechanical properties. The term "drawing" is also used incorrectly in reference to heat treatment where the word "tempering" should be used. On flat-rolled material, a process by which metal is forced into a cup-like or depressed shape by pressing into a die.

E

Electro-Polishing - A method of polishing in which the item to be polished is immersed in a suitable electrolyte while carefully controlled current is passed between the object and a cathode. The object to be polished is the anode, and polishing is obtained by a uniform removal of surface metal that goes into solution.

Elongation - A measure of ductility. In metals, elongation is expressed in terms of percentage, reflecting the difference in length between an original length and the extension of that length that takes place in a tensile test.

F

Fatigue - The tendency of a metal to break when subjected to repeated cyclic stresses considerably below its normal tensile strength.

Ferrite - A metallurgical phase of iron in which metallic alloying elements are in solid solution but carbon is essentially insoluble. Ferrite is virtually absent in quenched martensitic and austenitic stainless steels, but its presence characterizes ferritic stainless steels. Annealed martensitic steels contain ferrite and carbide.

Ferritic Stainless Steels - A term used to identify certain high-chromium content stainless steels Types 430, 430 F, 442 and 446. These steels are essentially non-hardenable by heat treatment and only slightly hardenable by cold work. They are magnetic in all conditions and have good scaling resistance. These steels are called ferritic because in any heat treated condition ferrite is the predominant phase. When viewed under a microscope it looks like a low-carbon iron.

Forging - A hot working operation generally involving plastic deformation of metal into desired shapes with compressive force.

Free-Machining Steel - Steel to which a small amount of some element, such as sulfur, selenium or lead is added to create a minute and widely distributed soft phase that aids machining.

H

Hammer Forging - A forging process in which metal stock is formed by repeated blows.

Hardenability - The response of an alloy to a specified heating and quenching cycle—usually understood to be the maximum hardness that can be attained with the individual heat using the specified heat treatment, as used in connection with the martensitic (hardenable) stainless steels.

Hardening - Generally a heat treatment used to increase the hardness of the steel. Technically the term refers to heating of hardenable steels to a temperature where austenite forms, then cooling to room temperature at a rate sufficiently rapid to produce martensite.

Hardness - Usually understood to be a resistance to indentation. Materials with little resistance are called soft; with high resistance, called hard. Measured in steel by scientific instruments as follows:

Brinell machine for sizes over 1/2-inch in diameter or thickness.

Rockwell machine for any size 1/2-inch to 1/8-inch in diameter or thickness.

Heat - The quantity of steel produced by a furnace in one melting.

Heat Number - An identifying number assigned to the product of one melting in an electric arc furnace: e.g. 18345. Frequently, but not universally, the first digit indicates the furnace number, the second digit indicates the year in which the heat was melted. The

last three (and sometimes four) digits show that this was the 345th heat melted in No. 1 furnace during 1968.

Heat Resistant Steel - Steel whose composition and treatment specifically prepare it for service at elevated temperatures. The term is less restrictive than "oxidation resistant" that refers to resistance to gaseous corrosion at high temperatures.

Heat Treatment - Any process involving heating metal to an elevated temperature to obtain change in properties or metallurgical structure.

Hot Rolled - Hot rolled products are those that are rolled to finish at temperatures above the recrystallization temperature.

Hot Working - The plastic deformation of metal at a temperature and rate that prohibits strain hardening.

I

Inclusions - Particles of non-metallic impurities, usually oxides, sulfides, or silicates that are mechanically held in steel during solidification.

Ingot - A special casting suitable for hot rolling or forging.

Intergranular Corrosion - Corrosion that occurs at the grain boundaries in austenitic stainless steels that have been heated between 850° and 1450°F.

M

Martensite - A hard metallurgical structure of steel. Formed by transformation of austenite during rapid cooling to room temperature. Its microstructure is an acicular or needle-like pattern.

Martensitic Stainless Steels - Family of chromium stainless steels that are hardenable by heat treatment and to some extent by cold work. They are magnetic in all conditions at room temperature.

Mechanical Properties - Those properties that reveal the reaction, either elastic or plastic, of a metal to an applied stress. Tensile strength, yield strength, elongation, reduction of area, hardness, impact strength and bendability are mechanical properties.

O

Orange Peel - Roughening of the surface sometimes encountered in forming or drawing stainless steels that have a coarse

grain structure.

Out-Of-Round - Circular wire or bars in which the diameter varies when measured in several places at the same location along the bar length.

P

Passivity - The ability of certain metals and alloys, especially the stainless steels, to resist normal corrosion tendencies to a point where the metal remains virtually unattacked, hence passive to its environment.

Physical Properties - The properties familiarly discussed in physics, exclusive of those listed under mechanical properties: for example, density, electrical conductivity, coefficient of thermal expansion.

Pickling - Removal of surface oxides by immersion in a chemically active solution such as dilute acids, molten caustic, etc.

Precipitation Hardening - Hardening that is caused by the precipitation of a metallic compound from a supersaturated solid solution.

Q

Quenching - Rapid cooling of a metal, usually by immersion in a liquid such as oil or water, to prevent, retain or regulate some change in its constitution.

R

Resquaring - A re-shearing of sheet and plates carried out after completion of all processing.

Rod - Any hot rolled or annealed and pickled round, square, octagon, hexagon, or shape in coils, only for cold drawing or cold rolling, 1/4" to 3/4" in diameter or size.

Rockwell Hardness - A numerical measurement of hardness derived from the depth of penetration into the metal of a small indenting head produced by application of fixed load. The Rockwell hardness test includes a number of variations for different hardness ranges. With stainless steel, the common scale is known as the C scale, based upon the penetration of a spheroconical diamond under a load of 150 kg.

Rough Turner - An operation for stock removal on round bars consisting of passing a bar through a set of rotating cutters.

S

Sensitization - A term used to describe the condition of the austenitic stainless steels resulting from heating them in the temperature range of approximately 800° to 1500°F and cooling to room temperature. When the metal is held in the sensitization range, the carbon in the steel combines with some of the chromium and precipitates as chromium carbide at the grain boundaries. This depletes the area at the grain boundaries of chromium and makes the metal susceptible in those areas to attack in some corrosive media.

Slitting - An operation that consists of pulling strip steel between two or more sets of circular knives or cutters mounted on two parallel arbors that may be geared to a driving motor. The revolving knives cut the strip as it passes between them. This process produces very accurate width tolerances but does not remove camber.

Soaking - Holding the metal at an elevated temperature to obtain a uniform temperature throughout the piece; or holding the metal at a very high temperature, approaching the melting point, to promote diffusion that will disperse segregations and produce a more uniform and homogeneous structure.

Stabilization - Prevention of the formation of harmful carbides at the grain boundaries of austenitic stainless steels by the use of additions of carbon stabilizing elements such as columbium or titanium. The term stabilization is also used to describe heat treatments for stabilizing carbides in austenitic stainless steels.

Stainless Steel - The broad classification of iron-base alloys containing at least 11 1/2% chromium that are known for the excellent corrosion and heat resistance. Other elements are also added to form alloys for special purposes in addition to the corrosion resistance imparted by chromium. Some of these elements are: nickel for increased corrosion resistance, particularly resistance to pitting, increased creep strength and high temperature strength; columbium and titanium for stabilization; sulfur and selenium for improved machinability.

Stress-Corrosion Cracking - Catastrophic failure by intragranular cracking occurring in austenitic stainless steels and other metals. It is caused by combined action of a corrosive environment and stress, often without outward appearances of general corrosion attack.

Stress Relieving - A heat treatment that reduces mechanical stresses resulting from such operations as straightening or cold drawing. The temperature used is not high enough to cause any substantial change in either the microstructure or mechanical properties. Also used to denote a low temperature of quenching stresses in martensitic steels.

Stretcher Strain - An angular surface pattern that can occur in Type 430 sheet and strip when formed, stretched or drawn. Lines can appear on either of the 45° angles to the rolling direction. This undesirable surface appearance is prevented when Type 430 is temper rolled after final annealing.

T

Temper - A term used as an indication of tensile strength or hardness of cold-worked sheet and strip. Temper in flat-rolled products is usually expressed as 1/4, 1/2, 3/4, or full hard. While these terms are frequently used when referring to wire, the preferred designation for wire should be the required tensile strength.

Thermal Conductivity - A measurement expressing the ability of a metal to conduct heat.

U

Ultimate Tensile Strength - The maximum stress in pounds per square inch (psi) that causes a material to fracture.

V

Vacuum Degassing - Usually applies to treating air melted steels and alloys to reduce the amount of dissolved gases. Vacuum is applied to the pouring operation ("steam degassing") or to the melt in the ladle ("ladle degassing"). There are other less commonly used techniques such as "Cyclic," "Pipette" or "Furnace" degassing.

Vacuum Induction Melting - Primary melting in an induction furnace in a vacuum chamber. This process prevents contamination from air and removes gases dissolved in the metal. It also insures close chemistry control.

Vacuum Melting - Melting in a vacuum to prevent contamination from air, as well as to remove gases dissolved in the metal.

W

Wire - Any cold finished round, square, octagon, hexagon or shape 1/2" and under in diameter or size. Any cold finished flat

1/16" to under 3/8" in width and .010" to under 3/16" in thickness.

Work Hardening - The hardness developed in metal as a result of cold work. The degree to which hardness and strength increases varies widely with different metals and alloys. Among the stainless steels the chromium-nickel grades are by far the most responsive.

Y

Yield Strength - The stress that causes a specified permanent increase in length of a tensile test specimen. For example, if a stainless steel alloy has a yield strength of 40,000 psi at 0.2% offset, a load of 40,000 pounds applied to a specimen having a section of one square inch would cause permanent elongation of .002 inch per inch of length of the specimen.