

Overview of terms

Age Hardening

Martensitic stainless steels are hardened by heating above their critical temperature, holding them at heat to insure uniform temperature, and cooling them rapidly by quenching in air or oil.

AISI (American Iron and Steel Institute)

A North American trade association with 50 member companies and over 100 associate members. These companies represent the United States, Canada, and Mexico in all aspects of the steel industry.

Alloy Surcharge

The producer's selling price plus a surcharge added to offset the increasing costs of raw materials caused by increasing alloy prices.

Annealing (Solution Annealing)

A process of heating cold stainless steel to obtain maximum softness and ductility by heat treatment which also produces a homogeneous structure (in austenitic grades) or a 50/50 mixture of austenite and ferrite by pickling (in duplex grades). It relieves stresses that have built up during cold working and insures maximum corrosion resistance.

Annealing can produce scale on the surface that must be removed .

Austenitic Stainless Steel

Non-magnetic stainless steels that contain nickel and chromium sufficient to develop and retain the austenitic phase at room temperature. Austenitic stainless steels are the most widely used category of stainless steel

Bars

Stainless steel formed into long shapes from billets. They can be rounds, squares, hexagons, octagons or flats, either hot or cold finished.

Beam

Long pieces of squared-off metal, normally stainless steel, which are used in building construction.

Bend Tests

Tests used to assess the ductility and malleability of stainless steel subjected to bending.

Billet

A semi-finished form of stainless steel that is used for long products such as bars and forgings. Billets are normally two to seven inches square.

Blank

A section of sheet stainless steel that has the outer dimensions of a specific part but has not yet been stamped by the end user. This lowers stainless steel processor's labour and transportation costs.

Bright Annealing

The same as annealing but carried out in an atmosphere that prevents tarnishing or scaling and therefore preserves the bright surface.

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Casting

To shape molten metal by pouring into a mold to produce an ingot or a continuously cast slab.

Centerless Grinding

An operation whereby the surface of a bar is ground without using a lathe.

Chemical Analysis

A report of the chemical composition of the elements, and their percentage that form a stainless steel product.

Charge

The material that is loaded into an electric furnace that will melt into a composition that will produce a

Chloride Stress Corrosion Cracking

Cracking due to the combination of tensile stress and corrosion in the presence of water and chlorides.

Chromium (Cr)

An alloying element that is used in stainless steel to deter corrosion.

Cladding

Application of a stainless steel coating to a lower-alloy steel by means of pouring, welding, or coating to increase corrosion resistance at a lower cost than using steel exclusively.

Coils

A sheet of stainless steel that has been rolled into a coil to facilitate transportation and storage.

Cold Finished Bars

Hot rolled stainless steel bars that are annealed and cold worked to produce a higher surface quality and higher strength.

Cold Forming (Cold Working)

Any mechanical operation that creates permanent deformation, such as bending, rolling, drawing, etc. performed at room temperature that increases the hardness and strength of the stainless steel.

Cold Reduction

Process of rolling cold coils of pickled hot-rolled sheet through a cold reduction mill to make the stainless steel stronger, thinner, and smoother by applying pressure.

Cold-Rolled Strip (Sheet)

Stainless steel that has been run through a cold reduction mill. Sheet is under 3/16th of an inch and 24" wide and over. Strip is under 3/16 of an inch and under 24" wide.

Cavitation

The rapid formation and depletion of air bubbles that can damage the material at the solid/liquid interface under conditions of severe turbulent flow.

Corrosion

The attack upon metals by chemical agents converting them to non-metallic products film created by the presence of chromium (and often other alloying elements, nickel, molybdenum) that resists this process.

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Corrosion Fatigue

Cracking due to repeating and fluctuating stresses in a corrosive environment.

Corrosion Potential

The potential of a corroding surface in an electrolyte relative to a reference electrode under open-circuit conditions.

Corrosion Rate

The rate at which an object corrodes.

Corrosion Resistance

A metal's ability to resist corrosion in a particular environment.

Deburring

Removing the subtle ridge from the edge of strip metal that results from cutting operation such as slitting, trimming, shearing, or blanking

Ductility

A measurement of the malleability of stainless steel in terms of the amount of deformation it will withstand before failure.

Duplex

Stainless steel comprised of austenitic and ferretic stainless steels that contain high amounts of chromium and nickel. This combination is stronger than both of the individual stainless steels.

Duplex stainless steels are highly resistant to corrosion and cracking.

Elongation

A measurement of ductility expressed in terms of the stretch having occurred over a given length on a standard tensile specimen at time of fracture, usually based upon an original length of 2 inches.

Embrittlement

A material's loss of malleability due to chemical treatment or physical change.

Erosion

The continuous depletion of a material due to mechanical interaction with a liquid, a multicomponent fluid, or solid particles carried with the fluid.

Extrusion

A shaped piece of stainless steel produced by forcing the bloom, bar, or rod through a die of the appropriate shape.

Fatigue

A condition leading to the eventual fracture of a material due to constant or repeated stresses that exert less pressure than the tensile strength of the material.

Ferritic

Magnetic stainless steels that have a low carbon content and contain chromium as the main alloying element, usually between 13% and 17%. It is the second most widely used stainless steel. Ferretic stainless steels are generally used in automotive trim and exhaust systems, hot water tanks, and interior architectural trim.

Overview of terms

Forging

Forming a hot or cold metal into a fixed shape by hammering, upsetting, or pressing.

Grain (Grain Boundary)

The individual crystal units comprising the aggregate structure where the crystalline orientation does not change. The grain boundary is where these individual crystal units meet.

Hardness Test

Hardness testing consists of pressing an indenter into a flat surface under a perfectly controlled load, then measuring the dimension of the resulting indentation. The three methods most commonly used for stainless steel are the Rockwell B, Rockwell C and Vickers tests. The higher the number, the harder the material.

Heat

Term referring to batch of refined stainless steel; a charged oxygen or electric furnace full of stainless steel. A heat of stainless steel can be used to cast several slabs, billets, or blooms.

Heat-Affected Zone (HAZ)

The part of a metal that is not melted during cutting, brazing, or welding, but whose microstructure and physical properties are altered by these processes.

Heat Treatment

Altering the properties of stainless steel by subjecting it to a series of temperature changes. To increase the hardness, strength, or ductility of stainless steel so that it is suitable for additional applications.

Hot Band (Hot-Rolled Stainless Steel)

Stainless steel that has been rolled on a hot-strip mill. It can be sold directly to customers or further processed into other finished products.

Hot Forming

Hot forming operations are used widely in the fabrication of stainless steel to take advantage of their lower resistance to shape change. High temperature reduces their yield strengths, and this results in a marked lowering of the force that is required to bring about plastic movement or flow from one shape to another (hot rolling, hot stretching, etc.).

Hydrogen Stress Cracking

Cracking of a metal resulting from the combination of hydrogen and tensile stress.

Impact Test

Impact testing is used to measure the toughness of a material, corresponding to the energy necessary to cause fracture under shock loading. Low toughness is generally associated with brittle shear fracture and high toughness with ductile plastic tearing.

Ingot

Semi-finished stainless steel that has been poured into molds and then solidified. The molds are then removed and the stainless steel is ready for rolling or forging.

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Line Pipe

A pipe extending over long distances that transports oil, natural gas, and other fluids.

Martensitic

A small category of magnetic stainless steels typically containing 12% chromium, a moderate level of carbon, and a very low level of nickel.

Mechanical Properties (Physical Properties)

Properties determined by mechanical testing, such as yield strength, ductility, ultimate tensile strength, hardness, bendability, impact strength, etc.

Molybdenum (Mo)

An alloying element that enhances corrosion resistance along with chromium in stainless steels.

Nickel (Ni)

An alloying element used in stainless steels to enhance ductility and corrosion resistance.

Nickel-Based Super alloys

Alloy metal produced for high-performance, high-temperature applications such as nickel-iron-chrome alloys and nickel-chrome-iron alloys.

Oxidation

Rust or corrosion due to exposure to oxygen.

Passivation

When exposed in air, stainless steels passivate naturally (due to the presence of chromium).

But the time required can vary. In order to ensure that the passive layer reforms rapidly after pickling, a passivation treatment is performed using a solution of nitric acid and water.

Pickling

A process that removes surface scale and oxidation products by immersion in a chemically active solution, such as sulphuric or hydrochloric acid.

Pitting

Localized corrosion (in the form of pits) of a metal surface that is confined to a small area.

Reinforcing Bar (Rebar)

A commodity-grade stainless steel used to reinforce concrete in highway and building structures.

Rod

Semi-finished stainless steel that is rolled from a billet and is commonly used for wire products, bolts, and nails.

Scale (Scale Removal)

The oxide that forms on the surface of stainless steel, after exposure to high temperature.

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Seamless Pipe

Pipe produced from a solid billet that is heated and rotated under pressure.

This rotating pressure creates a hole in the middle of the billet, which is then formed into a pipe by a mandrel.

Sensitization

The phenomenon in austenitic stainless steels that causes a change to occur in the grain boundaries when heated in the general range of 850 to 1475 degree F. This change destroys the passivity in these locations.

Shot Blasting

Blast cleaning using stainless steel shot as the abrasive.

Not recommended for stainless steel. Glass beads should be used.

Solution Heat Treatment

Heating a metal to a high temperature and maintaining it long enough for one or more constituents to enter the solid solution. The solution is then cooled rapidly to retain the constituents within.

Stainless Steel

Group of corrosion resistant steels containing at least 10.5% chromium and may contain other alloying elements. These steels resist corrosion and maintain its strength at high temperatures.

Stress Corrosion Cracking (SCC)

Slowly developing cracks that form in stainless steel due to mechanical stress and exposure to a corrosive environment.

Super alloys

Lightweight metal alloys designed specifically to withstand extreme conditions.

Conventional alloys are iron-based, cobalt-based, nickel-based, and titanium-based.

Tubing

When referring to OCTG, tubing is a separate pipe used within the casing to conduct the oil or gas to the surface.

Depending on conditions and well life, tubing may have to be replaced during the operational life of a well.

Wire

A cold finished stainless steel product (normally in coils) that is round, square, octagon, hexagon and flats under 3/16 inches.

Yield Strength

The stress beyond which stainless steel undergoes important permanent flow — commonly specified as that stress producing a 0.2% or 1.0% offset from the linear portion of the stress-strain curve.

Corrosion glossary

Accelerated corrosion testing

Testing, in which the rate of corrosion is increased by making conditions more severe than what is found in practice.

Activation

Changing the condition of steel from passive to active.

Activation potential

The electrode potential, at which a steel is changed from passive to active condition.

Active condition

Condition in which a steel can be dissolved or corroded.

Active-passive cell

A local cell consisting of a section in the active condition, acting as an anode, and a section in the passive condition, acting as a cathode. Commonly, oxygen reduction takes place at the cathode surface and metal dissolution at the anode surface.

Anode

An electrode, from which a positive electric current enters an electrolyte. The electrode reaction at an anode is oxidation, for instance: a) Oxidation of metal atoms in the anode material under production of ions in the electrolyte, e.g. $\text{Fe} \rightarrow \text{Fe}^{2+} + 2\text{e}^-$
b) Oxidation of ions or molecules in the electrolyte under production of electrons (collected by the anode), e.g. $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-$

Anodic protection

Electrochemical corrosion protection, achieved by increasing the electrode potential of the steel.

Atmospheric corrosion

Corrosion due to exposure at atmosphere, generally out of doors.

Atmospheric corrosion testing

Field trials in atmosphere.

Bright annealing

Annealing in inert gas or vacuum to prevent oxidation of the surface.

Cathode

An electrode, through which positive electric current leaves an electrolyte. The electrode reaction at a cathode is a reduction of ions or molecules in the electrolyte by electrons emitted from the cathode. In corrosion processes, reduction of dissolved oxygen and emission of hydrogen are two common reactions. The current flow causes positive ions to migrate towards the cathode.

Cathodic protection

Electrochemical corrosion protection by lowering the electrode potential.

Corrosion

Attack on a material through chemical or electrochemical reaction with a surrounding medium.

Corrosion glossary

Corrosion fatigue

Fatigue due to the effect of a corrosive medium.

Corrosion product

Reaction product formed through corrosion.

Corrosive solution

A solution that can cause corrosion.

Crevice corrosion

Localised corrosion in narrow crevices filled with liquid.

Electrochemical corrosion

Corrosion brought about through electrode reactions.

Electrochemical protection

The prevention of corrosion in an electrolyte by control of the electrode potential of steel.

Electrode

Electron conductor, through which electrons can enter and leave an electrolyte. Cf. Anode and Cathode.

Electrode potential

Potential difference between a test electrode and a reference electrode, e.g., a saturated calomel electrode, in a solution.

Electrode reaction

A chemical reaction at the surface of an electrode, in connection with electric current flow.

The reaction is a reduction in one direction, oxidation in the other.

Electrolyte

An electrically conducting medium, such as melted salt or a salt solution, in which electric current is transported by ions.

Erosion corrosion

Attack consisting of simultaneous erosion and corrosion through the effect of a rapidly flowing liquid.

Extraneous rust

Rust not originating from the steel under consideration, e.g., rust brought to the site from a rusting iron object by means of a flowing liquid, or formed by rusting of iron particles brought to the steel surface.

General corrosion

Corrosion taking place at about the same rate all over the surface affected by the corrosive medium.

Huey test

Corrosion testing in a boiling solution of nitric acid. This test is mainly used to detect the susceptibility to intergranular corrosion of stainless steel.

Corrosion glossary

Immunity

A thermodynamically stable condition.

Localised corrosion / attack

Corrosion taking place at a relatively high speed in limited sections of the area exposed to a corrosive medium.
Cf. General corrosion.

Mill scale

A thick oxide coating formed on the steel when heated, e.g., in connection with hot working or heat treatment.

Money-penny-Strauss test

Corrosion testing in a copper sulphate solution containing sulphuric acid.
Used to detect the susceptibility to intergranular corrosion of stainless steel.

Passivation

Changing steel from active to the passive condition

Passivation potential

The electrode potential at which steel is converted from the active to the passive condition.

Passivity

A condition, in which the anodic dissolution of a steel is strongly reduced by, e.g., a thin oxide film.
Passivity impedes the corrosion of steel.

Pickle / Pickling

A chemical or electrochemical method of removing mill scale, rust and similar coatings from steel.

Pickling bath

Solution used for pickling. The pickling bath is normally composed of acids, but can in electrolytic pickling consist of salt solution.

Pit

A corroded hollow in a metal surface, caused by localised corrosion (pitting).

Pitting

Localised corrosion causing attacks over small surface areas but reaching considerable depths.

Pitting potential

The electrode potential, above which there is a risk of pitting. The value of the pitting potential varies depending on testing conditions.

Redox potential

A measure of the oxidising ability of a solution. A solution having a high redox potential has a high oxidising ability.

Scaling temperature

The temperature, above which steel oxidises at a high rate.

Corrosion glossary

Selective corrosion

Corrosion characterised by single alloying components or phases being dissolved faster than the general body of the steel.

Sensitising

A heat treatment that makes steel more sensitive to intergranular corrosion.

Stabilisation

An addition of titanium or niobium, making stainless steels less sensitive to intergranular corrosion.

Stray current corrosion

Electrochemical corrosion caused by stray currents leaking from an electrical installation.

Stress corrosion cracking

Formation of cracks caused by the action of a corrosive medium, such as a chloridic solution, in combination with tensile stress.

Stress relieving

Heat treatment carried out in order to reduce internal stresses in steel.

U-bend specimen

Horseshoe-shaped test piece used to detect the susceptibility of a material to stress corrosion cracking.