

# Corrosion Glossary

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## sacrificial protection

Reduction of corrosion of a metal in an *electrolyte* by galvanically coupling it to a more anodic metal; a form of *cathodic protection*.

## salt fog test

An *accelerated corrosion test* in which specimens are exposed to a fine mist of a solution usually containing sodium chloride, but sometimes modified with other chemicals.

## salt spray test

See *salt fog test*.

## saturated calomel electrode

A *reference electrode* composed of mercury, mercurous chloride (calomel), and a saturated aqueous chloride solution.

## scaling

(1) The formation at high temperatures of thick corrosion product layers on a metal surface.  
(2) The deposition of water-insoluble constituents on a metal surface.

## season cracking

An obsolete historical term usually applied to *stress-corrosion crackling* of brass.

## selective leaching

Corrosion in which one element is preferentially removed from an alloy, leaving a residue (often porous) of the elements that are more resistant to the particular environment. Also called *dealloying* or *parting*. See also *decarburization*, *decobaltification*, *denickelification*, *dezincification*, and *graphitic corrosion*.

## sensitizing heat treatment

A heat treatment, whether accidental, intentional, or incidental (as during welding), that causes precipitation of constituents at grain boundaries, often causing the alloy to become susceptible to *intergranular corrosion* or *intergranular stress-corrosion cracking*. See also *sensitization*.

## sensitization

In austenitic stainless steels the precipitation of chromium carbides, usually at grain boundaries, on exposure to temperatures of about 550 to 850 °C (about 1000 to 1550 °F), leaving the grain boundaries depleted of chromium and therefore susceptible to preferential attack by a corroding (oxidizing) medium.

## shear

That type of force that causes or tends to cause two contiguous parts of the same body to slide relative to each other in a direction parallel to their plane of contact.

## stabilizing treatment

(1) Before finishing to final dimensions, repeatedly heating a ferrous or nonferrous part to or slightly above its normal operating temperature and then cooling to room temperature to ensure dimensional stability in service. (2) Transforming retained austenite in quenched hardenable steels, usually by cold treatment. (3) Heating a solution-treated stabilized grade of austenitic stainless steel to 870 to 900 °C (1600 to 1650 °F) to precipitate all carbon, as TiC, NbC, or TaC so that *sensitization* is avoided on subsequent exposure to elevated temperature.

## standard electrode potential

The reversible potential for an electrode process when all products and reactions are at unit activity on a scale in which the potential for the standard hydrogen half-cell is zero.

## strain

The unit of change in the size or shape of a body due to force. Also known as *nominal strain*.

## strain-age embrittlement

A loss in *ductility* accompanied by an increase in hardness and strength that occurs when low-carbon steel (especially rimmed or capped steel) is aged following *plastic deformation*. The degree of *embrittlement* is a function of aging time and temperature, occurring in a matter of minutes at about 200 °C (400 °F), but requiring a few hours to a year at room temperature.

## strain aging

*Aging* induced by cold working.

## strain hardening

An increase in hardness and strength caused by *plastic deformation* at temperatures below the recrystallization range.

## strain rate

The time rate of straining for the usual tensile test. Strain as measured directly on the specimen gage length is used for determining strain rate. Because strain is dimensionless, the units of strain rate are reciprocal time.

## stray current

Current flowing through paths other than the intended circuit.

## stray-current corrosion

Corrosion resulting from direct current flow through paths other than the intended circuit. For example, by an extraneous current in the earth.

## stress

The intensity of the internally

**shear strength**

The stress required to produce fracture in the plane of cross section, the conditions of loading being such that the directions of force and of resistance are parallel and opposite although their paths are offset a specified minimum amount. The maximum load divided by the original cross-sectional area of a section separated by shear.

**sigma phase**

A hard, brittle, nonmagnetic intermediate phase with a tetragonal crystal structure, containing 30 atoms per unit cell, space group  $P4_2mnm$ , occurring in many binary and ternary alloys of the transition elements. The composition of this phase in the various systems is not the same and the phase usually exhibits a wide range in homogeneity. Alloying with a third transition element usually enlarges the field of homogeneity and extends it deep into the ternary section.

**sigma-phase embrittlement**

*Embrittlement* of iron-chromium alloys (most notably austenitic stainless steels) caused by precipitation at grain boundaries of the hard, brittle intermetallic *sigma phase* during long periods of exposure to temperatures between approximately 560 and 980 °C (1050 and 1800 °F). Sigma-phase embrittlement results in severe loss in *toughness* and *ductility*, and can make the embrittled material susceptible to *intergranular corrosion*. See also *sensitization*.

**slip**

*Plastic deformation* by the irreversible shear displacement (translation) of one part of a crystal relative to another in a definite crystallographic direction and usually on a specific crystallographic plane. Sometimes called glide.

**slow strain rate technique**

An experimental technique for evaluating susceptibility to *stress-corrosion cracking*. It involves pulling the specimen to failure in uniaxial tension at a controlled slow strain rate while the specimen is in the test environment and examining the specimen for evidence of stress-corrosion cracking.

**slushing compound**

An obsolete term describing oil or grease coatings used to provide temporary protection against *atmospheric corrosion*.

**smelt**

Molten slag; in the pulp and paper industry, the cooking chemicals tapped from the recovery boiler as molten material and dissolved in the smelt tank as *green liquor*.

**S-N diagram**

A plot showing the relationship of stress,  $S$ , and the number of cycles,  $N$ , before fracture in fatigue testing.

**soft water**

distributed forces or components of forces that resist a change in the volume or shape of a material that is or has been subjected to external forces. Stress is expressed in force per unit area and is calculated on the basis of the original dimensions of the cross section of the specimen. Stress can be either direct (tension or compression) or shear. See also *residual stress*.

**stress concentration factor ( $K_t$ )**

A multiplying factor for applied stress that allows for the presence of a structural discontinuity such as a notch or hole;  $K_t$  equals the ratio of the greatest stress in the region of the discontinuity to the nominal stress for the entire section. Also called theoretical stress concentration factor.

**stress-corrosion cracking (SCC)**

A cracking process that requires the simultaneous action of a corrodent and sustained tensile stress. This excludes corrosion-reduced sections that fail by fast fracture. It also excludes intercrystalline or transcrystalline corrosion, which can disintegrate an alloy without applied or residual stress. Stress-corrosion cracking may occur in combination with *hydrogen embrittlement*.

**stress-intensity factor**

A scaling factor, usually denoted by the symbol  $K$ , used in *linear-elastic fracture mechanics* to describe the intensification of applied stress at the tip of a crack of known size and shape. At the onset of rapid crack propagation in any structure containing a crack, the factor is called the critical stress-intensity factor, or the *fracture toughness*. Various subscripts are used to denote different loading conditions or fracture toughnesses:  $K_{Ic}$  Plane-stress fracture toughness. The value of stress intensity at which crack propagation becomes rapid in sections thinner than those in which plane-strain conditions prevail.

$K_{Ic}$  Stress-intensity factor for a loading condition that displaced the crack faces in a direction normal to the crack plane (also known as the opening mode of deformation).

$K_{Ic}$  Plane-strain fracture toughness. The minimum value of  $K_{Ic}$  for any given material and condition, which is attained when rapid crack propagation in the opening mode is governed by plane-strain conditions.

$K_{Ia}$  Dynamic fracture toughness. The fracture toughness determined under dynamic loading conditions; it is used as an approximation of  $K_{Ic}$  for very tough materials.

$K_{Isc}$  Threshold stress-intensity factor for stress-corrosion cracking. The critical plane-strain stress intensity at the onset of stress-corrosion cracking under specified conditions.

$K_Q$  Provisional value for plane-strain

	Water that is free of magnesium or calcium salts.		
<b>solder embrittlement</b>	Reduction in mechanical properties of a metal as a result of local penetration of solder along grain boundaries.		
<b>solid-metal embrittlement</b>	The occurrence of <i>embrittlement</i> in a material below the melting point of the embrittling species. See also <i>liquid-metal embrittlement</i> .		
<b>solid solution</b>	A single, solid, homogeneous crystalline phase containing two or more chemical species.		
<b>solute</b>	The component of either a liquid or solid solution that is present to a lesser or minor extent: the component that is dissolved in the <i>solution</i> .		
<b>solution</b>	In chemistry, a homogeneous dispersion of two or more kinds of molecular or ionic species. Solution may be composed of any combination of liquids, solids, or gases, but they always consist of a single phase.		
<b>solution heat treatment</b>	Heating an alloy to a suitable temperature, holding at that temperature long enough to cause one or more constituents to enter into <i>solid solution</i> , and then cooling rapidly enough to hold these constituents in <i>solution</i> .		
<b>solution potential</b>	<i>Electrode potential</i> where half-cell reaction involves only the metal electrode and its ion.		
<b>solvent</b>	The component of either a liquid or <i>solid solution</i> that is present to a greater or major extent; the component that dissolves the <i>solute</i> .		
<b>sour gas</b>	A gaseous environment containing hydrogen sulfide and carbon dioxide in hydrocarbon reservoirs. Prolonged exposure to sour gas can lead to <i>hydrogen damage</i> , <i>sulfide-stress cracking</i> , and/or <i>stress-corrosion cracking</i> in ferrous alloys.		
<b>sour water</b>	Waste waters containing fetid materials, usually sulfur compounds.		
<b>Space Outgassing</b>	Release of contained gas in the vacuum of outer space. eg. rapid destructive expansion of plastics and similar materials.		
<b>Space Pitting</b>	Pitting resulting from ablation, outgassing or meteor contact.		
<b>spalling</b>	The spontaneous chipping, fragmentation, or separation of a surface or surface coating.		
<b>spheroidite</b>	An aggregate of iron or alloy carbides of essentially spherical shape dispersed throughout a matrix of <i>ferrite</i> .		
<b>sputtering</b>		fracture toughness.	
		$K_{th}$ . Threshold stress intensity for stress-corrosion cracking. The critical stress intensity at the onset of stress-corrosion cracking under specified conditions.	
		$DK$ . The range of the stress-intensity factor during a fatigue cycle.	
		<b>stress-intensity factor range, <math>DK</math></b>	
		In fatigue, the variation in the <i>stress-intensity factor</i> in cycle, that is, $K_{max}-K_{min}$ .	
		<b>stress raisers</b>	
		Changes in contour or discontinuities in structure that cause local increases in stress.	
		<b>stress ratio, <math>A</math> or <math>R</math></b>	
		The algebraic ratio of two specified stress values in a stress cycle. Two commonly used stress ratios are: (1) the ratio of the alternating stress amplitude to the mean stress. $A = S_a/S_m$ and (2) the ratio of the minimum stress to the maximum stress. $R = S_{min}/S_{max}$ .	
		<b>stress-relief cracking</b>	
		Also called postweld heat treatment cracking, stress-relief cracking occurs when susceptible alloys are subjected to thermal stress relief after welding to reduce <i>residual stresses</i> and improve <i>toughness</i> . Stress-relief cracking occurs only in metals that can precipitation-harden during such elevated-temperature exposure; it usually occurs at <i>stress raisers</i> , is <i>intergranular</i> in nature, and is generally observed in the coarse-grained region of the weld <i>heat-affected zone</i> . See also <i>cold cracking</i> , <i>hot cracking</i> , and <i>lamellar tearing</i> .	
		<b>stress relieving</b>	
		Heat treatment carried out in steel to reduce internal stresses.	
		<b>striation</b>	
		A fatigue fracture feature, often observed in electron micrographs, that indicates the position of the crack front after each succeeding cycle of stress. The distance between striations indicates the advance of the crack front across that crystal during one stress cycle, and a line normal to the striation indicates the direction of local crack propagation. See also <i>beach marks</i> .	
		<b>subsurface corrosion</b>	
		Formation of isolated particles of corrosion products beneath a metal surface. This results from the preferential reactions of certain alloy constituents to inward diffusion of oxygen, nitrogen, or sulfur.	
		<b>sulfidation</b>	
		The reaction of a metal or alloy with a sulfur-containing species to produce a sulfur compound that forms on or beneath the surface on the metal or alloy.	
		<b>sulfide stress cracking</b>	
		Brittle failure by cracking under the combined action of <i>tensile stress and corrosion</i> in the presence of water and hydrogen sulfide. See also <i>environmental cracking</i> .	

A coating process whereby thermally emitted electrons collide with inert gas atoms, which accelerate toward and impact a negatively charged electrode that is a target of the coating material. The impacting ions dislodge atoms of the target material, which are in turn projected to and deposited on the substrate to form the coating.

**surfactant**

A surface-active agent; usually an *organic* compound whose molecules contain a *hydrophilic* group at one end and a *lipophilic* group at the other.